ENGINEERS' SOCIETIES.

CIVIL ENGINEERS' CLUB OF CLEVELAND.

ANNUAL MEETING.

There was a large attendance of leading civil and mechanical engineers and others at the annual meeting held on the 10th inst. The following are copious extracts from the annual address of Vice-President J. F. Holloway, which gives a comprehensive view of the industrial progress of Cleveland:

Among the recently completed engineering works in our city and vicinity may be named the New York, Chicago & St. Louis Railroad. This road is somewhat noted as an example of rapid work, as the time elapsing between its survey and its completion was very short, notwithstanding there was considerable heavy work on some parts of the line. Its location and construction through the city required not only engineering skill, but the expenditure of a considerable sum of money as well. The iron viaduct which carries the road above and across the Valley of the Cuyahoga and the swing bridge at its high elevation above the water, are both examples of good practice in that class of work. In another direction we have the extension of the Valley Railway, reaching new and important coal fields in the interior of the State, which, while they will add business to the road, will also add importance to Cleveland as a center of iron, steel and other industries. The same may be said of the Connotton Valley Railway, which is also another avenue to extensive coal mines in a different direction. An engineering puzzle that for a long time baffled the skill of our friends in the engineer's office of the New York, Pennsylvania & Ohio Railway has recently found a solution, and the great fill of the "Tamarac Swamp" has at last touched bottom, and what was equally desirable, has touched grade as well. The rapid progress made during the year past upon the government breakwater would indicate an early completion of that valuable work, and we may hope soon to see what will be its effect, not only as a harbor of refuge for vessels, but also as a means of extending the facilities for shipping by reason of the greatly increased dock-room it will afford.

After a somewhat spirited and protracted contest, the site of the new reservoir for the city water-works has been decided upon, and within the coming year the work of constructing this important addition to the storage and distribution of water will be well under way.

Various industries of our city have been increased and widened in their scope by means of the erection of several large, commodious and well-planned buildings designed for manufacturing purposes, among which may be named the "Cummer Engine Works," designed for the construction of high-speed automatic cut-off steam engines. Adjoining the works last mentioned there has recently been completed what, without doubt, is the largest steam forge in the United States.

With the new and approved appliances with which the building is filled, together with the additional machinery recently added to the other similar establishments in this city, there can be no doubt of Cleveland retaining in the future, as in the past, its high reputation in the manufacture of forgings of all descriptions, including, as they do, wrought iron shafts of the largest size now required.

As indicative of the growing importance in which our city is held as a desirable and convenient point for the manufacture and distribution of various articles, there might be named several establishments that have been bodily removed from the Eastern States, as well as of instances where branches of well-known Eastern houses have been started among us.

Among the many things which have engaged the attention and interest of engineers, not only in this country but abroad as well, is that of making castings of steel. There are but few engineers engaged in structural work, who, I am certain, have not at various times felt the want of some material which, possessing sufficient fluidity to allow of its being run into molds, should also have a high tensile strength, and a percentage of elasticity that would admit of its receiving violent shocks without injury, and at the same time be free from "blow-holes" so as to admit of finishing, and which withal could be had at a reasonable price. Having watched with much interest the advancement that has of late years been made in the art of steel castings, and having had occasion to investigate the matter somewhat, I take pleasure in being able to say that so far as I have known, in no place have as rapid strides been made, both as to the improvement of the metal, as well as in the solidity and smoothness of the castings, as in our own city in the year just closed, and under the immediate care and skill of a member of this club, the superintendent of the Otis Steel Company.

It is well understood that the rapid growth and prosperity of Cleveland during these later years has been largely due to the fact that this is the nearest and most convenient point where the iron ores of Lake Superior can meet the coke, coal and limestone needed to convert them into metallic iron with the least expense of handling or transportation. Within a few weeks past there has been put in operation in our midst a blast furnace which, in its size and appointments, will enable this question to be tested under the most favorable circumstances. I refer to the "blowing in" of the No. 1 stack of the Cleveland Rolling Mill Company, at their central works above the Connotton Valley Railroad bridge and on the Cuyahoga River. The furnace is the largest of its class. The air is supplied by three of the largest-sized blowing engines, and is heated by three "Whitwell stoves." The ore is transferred by steam hoisting engines, over movable tramways, from the hold of the vessel to the foot of the hoisting tower which connects with the "top house" of the furnace. The furnace has been in blast but a brief period, and while the product has been steadily increasing from 150 to 200 and recently to 220 tons of pig iron per day, it is safe to say that when all the conditions are favorable the quantity of iron produced will equal, if not exceed, that of any furnace in the country. When you consider the immense quantity of ore, coke and limestone that must be moved and handled each day in order to produce this quantity of iron, you will understand how important it is that so far as it is possible to do so it should be done by mechanical contrivances. The success of the enterprise will be watched with much interest, and if its financial results shall prove as successful as has the engineering part of the scheme, it will not only be additional testimony of the wisdom and sagacity of that great iron master, Henry Chisholm, but it may also result, in the future, in placing Cleveland, Ohio, alongside of the Cleveland district of England, as one of the world's great centers in the production of pig iron. Since the above was written there has appeared in the papers a report of the action taken before the Legislature of Pennsylvania by various iron and steel companies in that State, in which, pleading for an exceptional low rate of freight in order that works situated so far inland may exist at all, they say that if they are not so favored they cannot hope to compete with Cleveland, whose superior location is universally acknowledged.

The annual reports were most interesting, and showed the club to be in a very flourishing condition. The election of officers resulted as follows: J. F. Holloway, President; B. F. Morse, Vice-President; A. Mordecai, Corresponding Secretary; M. W. Kingsley, Recording Secretary; and C. H. Hyde, Treasurer.

LIVERPOOL ENGINEERING SOCIETY.

The fourth meeting of the session was held Wednesday the 28th February, at the Royal Institute, Colquitt Street, Mr. F. Bramall in the chair, when a paper entitled "The Pittsburgh, Mc Keesport and Youghiogheny Railroad" was read by Mr. M. E. Yeatman, M. A. Cantab., late Assistant Engineer. The extent of the line is 56 miles southeast from Pittsburgh Pa., into the Connellsville coal field. The method of procedure in an American railroad comprises: Charter of Incorporation, Survey or "Preliminary Line" Levels, slope and topography, "Location." Contract let in this case at prices per cube yard before completing the location, scale of prices for "grading," masonry, timber, and ironwork. The line was separated into divisions and sections with a staff of divisional engineers taking cross sections for monthly estimates. The author then described the special feature of the line, the alternative route between Pittsburgh and McKeesport, the covered way provided at the American ironworks, the pile trestlework, the bridges, Monongahela viaduct and the Youghiogheny Bridge, and concluding with a description of the permanent way and a comparison of English and American railways.

BOSTON SOCIETY OF CIVIL ENGINEERS.

The annual meeting of the Boston Society of Civil Engineers was held at Young's Hotel on the evening of the 21st. Besides the transaction of routine business, reports of progress were received from the Special Committees on the Introduction ot the Metric System and on the Class List of Engineering Works in the Public Library, and the committees were continued. The reports of the Secretary and Treasurer showed the society to be in a flourishing condition as regards membership, with a surplus of funds in the treasury. The following officers were elected: President, Thomas Doane; Vice-President, Edward S. Philbrick; Secretary, H. L. Eaton; Treasurer, Henry Manley; Librarian, C. W. Kettell.

The annual meeting was followed by the first annual dinner of the society, at which some sixty plates were set.

President Doane occupied the head of the table, and there were present as guests, Major C. W. Raymond, U. S. Corps of Engineers, Harbor Commissioner H. L. Whiting, L. W. Rundlett, City Engineer, St. Paul, Minn., H. M. Howe, Vice-President American Institute of Mining Engineers, S. E. Tinkham, former Secretary of the Society, and Rev. A. S. Twombly, Charleston, Mass.

After the dinner had been well attended to President Doane alluded to the history of the society as follows: The first regular meeting was held July 3, 1848, and an act of incorporation was approved April 24, 1851. The Society continued prosperous and its meetings well attended until the spring of 1855. After that time very few meetings were attended by a quorum, and no business could be transacted.

A meeting was held Sept. 13, 1861, at which a committee was appointed to take charge of the assets of the society, and no further meetings were held until April 27, 1874. At this meeting Mr. James B. Francis was elected President, and Samuel Nott, Secretary, and a number of gentlemen who were members of a society organized May 30, 1873, which society had unwittingly taken the name of the former society, were proposed for membership in the Boston Society of Civil Engineers. These gentlemen were elected members of the society June 5, 1874. Since its reorganization the society has had a very prosperous existence.

Speeches were made at the conclusion of the President's address by Desmond Fitzgerald, Supt. Western Division, Boston Water-Works, and first President of the society organized May 30, 1873; Mr. Laurence Bradford, recently connected with the Mexican Central R. R.; H. L. Whiting, member of the Mass. State Board of Harbor & Land Commissioners; Major C. W. Raymond, U. S. Corps of Engineers; Clemens Herschel, Engineer Holyoke Water Power Co., Holyoke, Mass.; Howard A. Carson, Boston; Prof. George L. Vose, Mass. Institute of Technology; Henry M. Hightman, City Engineer, Boston; and Rev. A. S. Twombly, Charlestown, Mass.

Letters were read from John Bogart, Secretary American Society of Civil Engineers; Samuel Nott, Hartford, Conn.; Joseph P. Davis, with Metropolitan Tel. & Tel. Co., formerly City Engineer of Boston; F. W. D. Holbrook, Superior, Wis.; T. Appleton, T. S. & W. R.R., Council Grove, Kan., and others.

Vocal music was rendered by the Mendelssohn Quartet.

The dinner was a success in every way, and the occasion was one long to be remembered by those present.

The committee of arrangement was Henry Manley.

H. S. EATON,
Secretary, B. S. C. E.

ON THE USE OF BUILDING STONES.*

BY JAMES GOWANS.

[From the London Architect].

In the paper I had the privilege of bringing before the Association last winter, I pointed out the characteristics of good building stones, and the principal quarries in Scotland from which such could be got. I stated that what the architect had to look for was a stone that was durable, strong, and of a color which would best bring out the architectural features of his design and harmonize with the locality and surroundings in which it was placed. We have, fortunately, within easy reach, abundance of stone combining these qualities; but, however good or beautiful it may be, if wrongly used, disappointment and failure are sure to be the result.

The laws observed in regulating the elements and forces in nature are thoroughly geometric, and the same laws are equally binding on the architect in his works. The constructive lines on which nature proceeds never fail, when free from debasing influences, to secure what we call beautiful in form, color, or usefulness; and the same lines cannot be too closely followed by the architect or builder who desires to reach excellence in an art which is noble in the highest sense of that word.

I know that it is held by many that the architect or artist is only trammeled in his conceptions by working on geometric lines. Some men, no doubt, have an intuitive perception of what is symmetrical and beautiful, either as to form or color, just as there are those who, without the aid of gamut or scale, have an inborn knowledge of what is harmonious in music; but I hold that in architecture, as applied to the true styles, a geometric basis is at the root of what we admire in the examples we have of these; and that, if a new style of architecture is to be developed, we must fall back on what guided the old designers in their original conceptions of what was not only true to its use, true in construction, true in symmetry, but beautiful as well, because it *was true*—the cube, the circle, and its geometric development giving that which we admire and call Classic, while the circle and the equilateral triangle supply the key to those noble Gothic structures which were erected five hundred years ago.

* A Paper read at a meeting of the Edinburgh Architectural Association on the 17th inst.

Before I enter upon the consideration of the uses of stone, I wish in a sentence or two to notice the use of timber and iron as constructive materials. There is a true way of using these, just as there is a true way of using other building material, such as stone; but a serious mistake will be made by the architect or engineer if they attempt to use these on the same lines or for purposes which by their nature they are not at all applicable. As to the first, the designer who understands what timber as a constructive material can do would never think of using it for the purposes of an arch; especially one which has to meet the strain of a vertical and moving load. Yet this has been done on some of our most important railways in the construction of bridges and viaducts. Neither should iron be used for purposes which stone or other material is only fit for. To build a structure on constructive lines which admit of play or movement when the weight and thrust of a railway train or moving force comes against it, or upon it, is certain in time to be fatal. Hence the care that should be taken, whether with stone, wood or iron, to adopt a system of construction which will not only meet the nature of such material, but the work it has to do.

To unite wood and iron, where their opposite properties can never harmonize and work together, is sure to fail in the long run, as, under a strain or load, timber, from its greater elasticity, will yield to the pressure, but again recover its normal condition after the strain or load is removed. Iron, on the other hand, will keep the set it gets, and if united to the timber, is certain to drag it down to the weakness which is inherent to such a combination of material.

What I have said about wood and iron is rather aside to my paper, except in illustration of what I consider so nearly allied to the use of stone that I trust the Association will overlook the digression. The right use of stone is my subject, and I will endeavor to keep as close to my text as possible, giving in a practical way the results of my own experience, and what I have learned from others. To be in order I will consider:

1. How to secure a foundation upon which the structure can be safely built.
2. How to place stone in the building so as to secure the greatest strength and durability.
3. How to use stone in the laying of a good foundation.
4. How to use stone in the building of retaining walls.
5. How to use stone in the building of rubble.
6. How to use stone in the superstructure.
7. How to use stone for coursed work.
8. How to use stone for ashlar work.
9. How to dress stone so as to get the most durable surface.

1. *How to Secure a Foundation upon which the Structure can be Safely Built.*

The foundation of a building is of primary importance, as, unless it is secure, the permanency of the structure cannot be maintained, however well built it may be.

Before laying a stone, the architect or engineer should be satisfied that the strata will give equal resistance to the pressure that may be put upon it.

Strata that is hard and soft is very dangerous. Even clay if mixed with boulders (which often happens) cannot be depended upon, unless they are removed, and means taken to equalize the ground on which the buildings are to be erected.

Next to rock, no better foundation can be got than sand or gravel when dry. If wet, means should be taken to drain away the water; but, if this cannot be done, large, flat-bedded foundation stones of sufficient area, fairly dressed in beds and joints, and well put together, will, as the load increases, secure a foundation that anything can be built upon.

In my own experience I have often tested this, and particularly when building a bridge on a railway contract I had many years ago. This was an under bridge of considerable span, the girders being in the form of an arch, in segments of cast iron, the security of which depended greatly on the permanent resistance of the abutments, or the bolts which held these segments together at their joints. In digging for a foundation, it was found that the strata was very soft, being layers of sand and moss alternately, and to prevent failure I took the precaution to strengthen the foundation of the first abutment by driving piles to a depth of 30 to 40 feet, with horizontal planking, on which the foundation stones were bedded. Before building the second abutment, acting on the advice of a railway contractor who had had more experience than myself, I adopted a different plan, viz., to dig out the soft material to such a depth and area as secured an outward resistance to meet the pressure of the large-sized stones that were afterward put into the foundation, course after course, until the load pressed out the water, and so secured a foundation which was equally as strong, if not stronger, than the first.

Where the strata is unequal or not to be depended upon, I know of nothing better than a good bed of concrete, certainly not less than 3 ft. thick, and no architect should neglect this where there is the slightest doubt as to the sustaining character of the ground. This is always necessary in erections of different heights, and is particularly required in churches and other buildings where the spire, tower, or other elevation bears more heavily on the foundation than the walls which abut upon them. And, in addition to this, and to make sure, I would have extra courses in the foundation of the higher and heavier portions, as in the hurry with which we build nowadays every precaution is necessary. The same care should be taken with respect to oriel windows or projections which do not go to the full height of the building, and consequently have not the same pressure on the foundation.

The walls to which these lighter projections are attached should not only be well founded, but the tie or bond which unites the one wall to the other should be left free on the upper beds, so as to allow for the subsidence of the heavier wall without causing the fractures so often seen where this precaution is not taken.

2. *How to Place Stone in the Building so as to Secure the greatest Strength and Durability.*

Before saying anything as to the various kinds of work put upon stone, or the modes of building, let me state that for durability all stones should be laid on their natural beds, especially such as are highly stratified. All stones, however compact in their nature, have a line of fracture, which the quarryman or hewer can easily detect; and although there are a few stones, such as the Liver Rock of Cragleith, Binnie and Redhall, which show little lamination, and may be used with the natural face exposed, the use of stone in this way should be the exception and not the rule.

Another consideration in the use of stone for important buildings is that of having it quarried, stored and seasoned for some time before being hewn and placed in the walls. By these means the natural sap is allowed to evaporate, and the stone tested as to its quality. This would add to the cost; but the money would be well spent if this precaution prevented the wasting of stones from the rains, frosts, or atmospheric influences, which, especially in our cities, soon act on the surface of a newly-quarried stone.

Stone that is quarried the one day and built in the next is in a green state and unfit for use. It is not in condition—it is at its weakest; its pores are open and ready to absorb not only moisture, but the gaseous and disfiguring influences which tend to its destruction. Every hewer knows that to get a polished surface on a stone that has lain for some time is very different from what he gets on one fresh from the quarry, and this of itself should be sufficient evidence to warrant the precaution I have recommended, which is to thoroughly season the stone before using.

To know what *good* stone really is, and how it can be best used, the architect who practices in this city, or the student, has not far to go to see not only the most durable stone, but also variety of masonry, as exemplified in such as Holyrood, Heriot's Hospital, and the residential buildings of the Old Town, erected centuries ago; or, turning to the modern buildings of the New Town, stone of equal durability and variety of masonry, as shown in the polished work of the better class buildings of the terraces, crescents and squares, such as Royal Terrace, Randolph Crescent, Moray Place or Charlotte Square; while in George Square, Gilmore Place, Thistle Street, Rose Street or Jamaica Street, work of a cheaper kind has been adopted, all of which are not only instructive, but interesting, in showing what masons could then do in erecting buildings that have stood the test of time, which makes no mistake in exposing what is good or bad in many things besides the art of building. My next consideration is

3. *How to Use Stone in Laying a Good Foundation.*

In my paper on "Building Stones" I gave the result of some experiments in testing foundation-stones for the chimney of the Edinburgh Gas Company, and the results of these experiments proved to my mind that as you enlarge the area of the stone a greater proportion of resistance is gained, and that a laminated stone, such as Hailes, would increase in strength according to its surface more in proportion than that of a Liver Rock stone, such as Redhall or Craigleith.

I notice this more particularly to show that a soft stone need not be rejected if laminated, of large area, fairly dressed on the beds and joints, and bedded on what I would call a swimming bed of mortar, so that every portion of the surface of the stone would get a fair share of the work it had to do.

Foundations should have the courses of sufficient breadth to admit of scarcements on either side and all round, so that the wall pier or pillar resting thereon may have a good footing, and equal resistance through and through to prevent sinking. I have known, from the neglect of this, worse than subsidence happen, owing to the foundation courses being filled with ordinary rubble in the center, which, yielding when the pressure came, brought down the building, involving not only loss of life and property, but questions of responsibility that had to be settled in a court of law.

The subsidence of the walls of a building occasioned by a bad foundation or inferior work above does not show itself all at once—it takes time to tell whether the foundations have been well or ill laid upon an unyielding strata, badly bedded stones or a faulty construction; but once it does begin to fracture, the unequal, and what I would call the unfair, strain that is thrown upon other portions soon leads to serious consequences.

4. *How to use Stone in the Building of Retaining Walls.*

The chief object here is to build so as to lean to and resist pressure from behind. To do this satisfactorily the excavations should be dug deep enough to secure the resistance necessary to meet the thrust when it comes; the walls should be built of the largest material that can be got, and bedded at right angles to the batter on the face. Small-sized stones in such a wall are useless. Heavy material, well dressed and bonded together so that when the pressure comes—in most cases suddenly—every stone will be ready to take its fair share in preventing an overthrow—that is what is wanted, not small-sized material which has no time to bond and get that unity of resistance which such a structure requires.

5. *How to use Stone in the Building of Rubble.*

Of walls built of rubble there is a great variety. Common rubble masonry or walls built with stones of irregular shape as they come from the quarries, if well put together, well dressed, well knocked to their bed, and built from front to back, so as to bond and get them to work together, enduring walls may be built; but if, on the other hand, as is too often the practice, such work is done by running up one side of the wall before the other, without bond or ties, such as are required to unite the whole, then nothing but failure can be the result.

There is another kind of rubble of which we have some admirable examples in the city—that is, coursed rubble. This work was done entirely with the piened hammer, without chisel mark of any kind; and when well bonded and backed, walls of the most enduring kind were got.

Where what is called squared rubble is adopted, with ordinary rubble for backing, the practice of running up the outer face should not be allowed. No worse masonry could be built than this, and it is to be regretted that so much of this kind of work is being done in our city. It is not only bad in itself, but leads to our younger masons being trained to a most objectionable style.

Speculation in building, where cost appears to be the first consideration, has led to much of this kind of work, although I am by no means sure but whatthere is something else to be blamed, and that is that many of our masons have not been properly trained, owing greatly to their being allowed to break their indenture, and not serving their full time of apprenticeship.

Masons were better trained when it was more the custom than it is now of indenturing apprentices for a term of years, usually five. Three were devoted to the art of hewing, and two to the art of building. When the term expired it was usual for the master to attach a certificate to the indenture stating how good an apprentice he had been, and his qualification to take his place as journeyman; and he was proud of the document as showing what he was and what he could do. This was a good custom, and one which I would like to see revived by the masters or workmen's unions, whose interest it should be to have well-trained men in their ranks.

In specifying rubble work architects should be careful in making clear the kind of work they require, as many questions have had to be settled in court which might have been avoided if more clearly described, or if, what is better still than any specification, the kind of work was shown to contractors before estimating.

There are so many different kinds of rubble, such as common, squared, random, hammer-dressed, nidged, and pick-dressed rubble, and rubble where the stones are limited in length, height, and breadth of bed, which comes to be a puzzle to the mason, if specified for walls, such as I have seen built in this city. These should be made perfectly clear by the architect by sample, so as to prevent after disputes, and show exactly how the stone is to be treated.

Another kind of rubble which was much in vogue when the houses in Moray Place, etc., were built, as shown in the back walls of the same, and also in the front of the older houses in George Square and Gilmore Place, was that of coursed rubble. As the term indicates, the stone was taken from the rubble, squared and faced entirely with the cairn hammer I have before alluded to, and it is well to notice from these examples how shapely and well done the work is—some of it brought to a surface by squaring the stone so as to show the natural face, and others by using the

piened hammer for dressing off any inequalities, and bringing it more within the term of what we call "nidged" work, only with much less labor than that required for this more costly style of masonry.

6. *How to use Stones in the Superstructure.*

There are many ways of building, but whatever kind of work is adopted, whether ordinary rubble stone, cubic stone, or ashlar, the great secret is to make every stone do its fair share. The true way of doing this is to build the walls from front to back of stone as nearly equal in thickness as possible—that is, of stones of cubic dimensions, or stones of a large area, examples of which we have in the remains of Egyptian and Cyclopean masonry. This is particularly desirable in the space between the foundation courses, and where the face of the wall comes to be seen; good masonry is required for this, although it is often otherwise, owing perhaps to its being buried and out of sight. For the abutments of bridges or piers of viaducts, cubic stone only can be used with safety. Where a great load has to be carried, to build with cubic stone facing and rubble stone backing is a mistake, unless the rubble stone is of large size and carefully bedded. With cubic stone and ordinary rubble you have in the outer face of the wall fewer beds and less mortar than in the backing, so that when the strain comes there is fracture, or a tendency for the wall to yield to the weaker side. Walls, as a rule, are much too thin to allow of the interior of a building being kept at a desirable temperature; thick walls are necessary. I would have all outer walls not less than 2 ft. 6 in., and, as applied to chimney-heads, you will never have a good draught in chimneys that are thin after passing through the roof. Unless they are thick, the current gets chilled and choked, owing to the cold damp air it meets with from the thinness of the masonry; and, further, it leads to disfigurement, by the use of cans, cowls and such like contrivances, of what the architect should make one of the most telling features.

7. *How to use Stone for Coursed Work.*

The variety of this work lies more in the mode of dressing than of building. There are, for instance, hammer-dressed and nidged coursing, both done with the hammer, the difference between which has led to many disputes.

Specimens of ordinary hammer-dressed coursing may be seen on the back walls of the older buildings of the New Town, while in many of the same where modern additions have been made, nidged coursers have been used, both as different as to cost as that of ashlar and ordinary rubble work.

There is also pick-dabbed coursing, which requires to be clearly defined, as without a specimen it may be interpreted to mean work done with the ordinary pick, which belongs to the builder; or it may mean work which can only be done by the point or pick dabber of the hewer. But before leaving this part of my subject, I do not know that anything more valuable could be done through your association than to have a clear and well-considered specification prepared, treating of all kinds of work. This would be certain to lessen, at least, the difference, so often arising between architects and builders as to what is meant.

8. *How to Build with Ashlar-facing and Rubble Backing.*

For ordinary purposes, where there is no great load to carry, to build a substantial wall the ashlar should be well squared on the beds and joints, and laid in a good swimming bed of lime, not stones with slack beds, which the builder has to pin up to bring to the plum, but square, well-hewn beds which will bear equally on the mortar and stones below. The builder has no excuse for not bedding them well, as with the machinery now in use, such as steam cranes and such like appliances, he never needs to put his hand to the stone, but can at once have it lifted and rebedded without the slightest effort or trouble on his part.

A great mistake is often made in laying ashlar with too thin a bed of lime, and also jointing too closely. This may look well, but hard to hard is bad masonry, as when the pressure does come a fracture from the face is sure to follow; and I have observed building where the architect or clerk of works was anxious to show thin beds and close joints sadly defaced although otherwise well built, and that with the hardest of material. All ashlar work after being backed up should have the joints well grouted with thin lime; this especially in walls that are much exposed to rain and in such a climate as ours.

The backing of ashlar, or hewn work of any kind, should be of large-sized rubble—every stone being well knocked to its bed—not simply tapped with the light hammer now in use or the edge of the trowel, but with the old-fashioned cairn hammer, which every good builder had beside him on the scaffold fifty years ago.

I cannot help noticing here how different the tools which builders now use are from what they were in the time I have referred to. Then they had a large-sized trowel with which they did not spare the mortar, and the large hammer which was freely used and never failed to bring the stone to its bed. Another tool was the hawk hammer, with one end of which the stone was squared, and other inequalities were dressed off. The mash and and pincher, first used by the hewer forty years ago, were handy tools for bending the checks of rybats, and removing the rough along the edges of the stone. Now these, with the clourer, are part of the builder's kit, and are used by him for doing that which the older hands accomplish with the hammer—work that was not only cheaply done, but far more tradesmanlike in appearance. Now it is a small trowel and the slighest of hammers, which if used, scarcely affects the stone at all. In short, the ordinary rubble building of the present day is not such as will maintain the character our Scotch masons had when I first remember.

9. *How to Dress Stone so as to get the Most Durable Surface.*

Of the various kinds of work adopted, and of which we have admirable examples in this city, I am of opinion that polished work is the best, not only for securing durability to the stone, but also for bringing out the beauty of its texture and color. Hammer-dressed, nidged, pick-dabbed, broached, scrabbled, droved and tooled work, all tend to bruise the surface of the stone and thus expose it to the atmosphere; while the rubbing necessary for polishing removes the bruised material, and presents to wasting agents a surface more likely to prevent decay than any other kind of work we know of.

I have endeavored to make this paper as practical as possible. Its consideration may be of some value to the architectural student, as it is a matter of regret that building on which the architect rests his reputation, and to which his genius has been applied, should perish either from faulty stone or bad masonry.

Five hundred years ago, when those beautiful examples of Gothic architicture were erected, with their traceried windows and vaulted roofs, the architect and builder seem to have gone hand in hand, not only in planning, but in building up on true constructive principles edifices which have withstood the ravages of time for so long a period.

Before closing I wish to allude to a custom which prevailed when such buildings as Heriot's Hospital were erected. Then every hewer indented his mark on the face of the stone he had hewn, and it may be of interest to visit this building and observe how carefully this was adhered to. You can by these means nearly ascertain how many hewers were employed on the work, how the structure was built up round and round and how those most expert in their craft had allotted to them the stones to dress which required the greatest skill. I have seen the same marks on buildings I have examined all over the country. I had a hobby for collecting these some years ago, and visited many of the principal cathedrals and buildings in England. I made a large collection, but unfortunately have lost the record. But it is a custom I should like to see revived, as, in my opinion, it would not deface the stone if done with the delicate and enduring touch which these old masons gave to work to which, no doubt, they attached a high value. Mark masonry, as one of the degrees in Freemasonry, had very likely something to do with the custom, but, although a Freemason myself, my paper precludes me following this phase of the craft further than to mention it as something that is at any rate suggestive.

With these examples before us, the appliances we have, and the teaching which every architectural student or working mason can get, we should be able to cope with those who have preceded it. I believe in the earnestness of the architectural student of the present day, but I am not so sure about the technical teaching or training the apprentice mason seeks after. When I first remember there were in the city many drawing-classes, chiefly attended by young men, who were either masons, carpenters, engineers or mechanics of a like kind. There were Ruthven, on the Bridges; Milne, St. James Square; Moffatt, George street; Paterson, Stockbridge and others—all teaching drawing, and making good incomes from the crowded houses that attended them. Now we have such institutions as the School of Arts to take their place; but I question very much if the classes are as well attended there as the others were in the time I have referred to. Besides this, there was at every important building a drawing-class, usually conducted by the chief foreman or clerk of works, which had the effect of theoretically educating the workman to a proficiency he could not otherwise have attained. In every squad there were numbers of men who were fit, from their intelligence and training to act, as clerk of works or fireman; and, in mentioning the former, I am of opinion that the well-trained mason is better for such a trust than the joiner.

No mason or joiner can be perfect in his trade or have his heart in it without a knowledge of drawing. As to masonry, I know of no trade that affords greater scope to the studious mind. To be proficient his head and his hands must work together. There is endless variety in the operations he has to perform, and it is far removed from work that is nearly, if not altogether, mechanical. I trust that as education (especially technical) advances, we may have a race of masons who will be something beyond mere machines and who, by their training, will help in no small degree our architects to carry out buildings whose architecture will be worth copying even by generations to follow us.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 121.)

DXII.—AMESVILLE, CONN.

Amesville, Connecticut, in lat. 41° 58 N., long. 73° 22' W. at the head of the Great Falls of the Housatonic River, is on irregular limestone ridges. It is half a mile from the post-office of Falls Village and is the site of the repair shops of the Housatonic Railroad Company.

Water-works were built in 1872 by the railroad company after the plans and under superintendence of W. E. Pettee, taking the supply from a large spring which issues from the limestone rock on the slope of Prospect Hill about 170 feet above the railroad shops. The hill rises about 600 ft. higher.

The spring is walled up, making a basin 9 by 15 ft. and 8 ft. deep. The water is conveyed to the village and shops by 2½-in. pipes made of old boiler flues cleaned out, the ends squared and having threads cut on them which screw into cast-iron coupling collars. The surplus flow is led into a reservoir 50 ft. in diameter and 20 ft. deep, lined with stone masonry and arched over and covered with 3 ft. of earth, at 110 ft. below the spring, being 60 ft. above the shops, and 25 ft. above the main street. This reservoir is used principally for the railroad service, and when its supply is deficient, water is pumped to it from the river. There are 4,500 ft. of main pipe in use, with 20 gates and 50 taps. There are no fire hydrants. Service pipes are of wrought iron. The population in 1880 was 377. The cost of the works is not known. The annual expenses and maintenance are $25. N. Slingland, the Master Mechanic of the railroad, manages the works.

DXIII.—PHENIX FURNACE, N. Y.

Phenix Furnace, New York, in lat. 42° N., long. 73° 30' W., is on the shore of the Rudd Pond, a mountain lake about 800 ft. above tide level.

Water-works were built in 1865, after plans of W. E. Pettee, C. E., as part of the development of the wire and furnace property of C. S. Maltby.

The supply is taken from a water shed of about 3 square miles of mountain lands, the flow of which is impounded by a stone dam 15 ft. high and 60 ft. long across a ravine. This reservoir covers half an acre. Another storage reservoir of 25 acres is constructed 500 ft. higher up the mountain, by a dam of earth with a stone heart wall, 15 ft. high and 400 ft. long.

The lower or distributing reservor is from 90 to 140 ft. above the village, to which the water is conveyed in a 4 in. cement pipe, 1¼ miles of which is in use, with 7 fire hydrants, 10 gates and 8 taps. Service pipes are of galvanized iron.

The supply is sufficient for 14 houses, 4 stables, the iron furnace and machine shops, and ordinarily for the wash works. In case of a deficient supply for the last, water is pumped up 20 ft. from the iron mine.

The works cost $3,000. The annual expense of maintenance is $100.

A. J. Copp is superintendent of the works.

DXIV.—BELLEFONTE, PA.

Bellefonte, Pennsylvania, in lat. 40° 55' N., long. 77° 50' W., is on Spring Creek, in a very hilly limestone region.

Settled in 1795, it was incorporated a borough in 1806.

Water-works were built by the borough in 1807, taking the supply from a copious spring whence the town derives its name.

The water of the spring is ponded by a dam 6 ft. high, and is pumped 196 ft. by two single acting plunger pumps driven by water power, and also by a steam pump, into a reservoir holding 290,000 gallons.

Distribution is by cast-iron pipes of from 6 to 2 in. diameter, with 40 fire hydrants. There is no record of the number of taps.

The population in 1880 was 3,015. The daily consumption is estimated at 300,000 gallons.

The cost of the works is given as $100,000 and the bonded debt as $118,995 at 5 to 7 per cent. interest. The expenses in 1882 were $3,800 and the receipts $4,500.

The works are managed by a committee of the borough council. W. W. Bateman is the Superintendent.

DXV.—GOSHEN, IND.

Goshen, Indiana, in lat. 41° 37 N., long. 85° 59' W., is on level ground on Elkhart River. Settled in 1843, it was incorporated a city in 1867. Water-

works were built by the city in 1881, taking the supply from six artesian wells 50 ft. deep. Their yield is stated to be 200,000 gallons daily. The water is pumped by a Dean Bros. steam pump into a brick reservoir 28 ft. in diameter and 26 ft. deep, and in case of fire directly into the mains, with 80 lbs. pressure.

Distribution is by 4 miles of Wyckoff wooden pipe of from 12 to 4 in. diameter, with 48 fire hydrants, 10 gates and 100 taps. Service pipes are of lead, iron and galvanized iron.

The population in 1880 was 1,123.

The daily consumption is not known.

The works cost $45,000. The bonded debt is $30,000 at 5 per cent. interest.

The expenses in 1882 were $2,000, and the receipts $1,100.

The works are managed by a board of commissioners. Lew Wanner is the Superintendent.

(TO BE CONTINUED.)

The receipt of statistics as follows, is acknowledged with thanks.

From J. M. Bell, statistics of Bellefonte (Pa.) water-works.

From Lew Wanner, Superintendent, statistics of Goshen (Indiana) water-works.

From James H. Mayhew, statistics of Huntsville (Alabama) water-works.

RAILWAY FARES FIXED BY ZONES.—Serious steps are about to be taken by the Government Railway Bureau of Germany for introducing a tariff of passenger fares by "zones," on the Prussian, if not all the German lines. Reducing the kilometres to miles, and the marks, etc., to dollars and cents, the fares would be about as follows: Distances not exceeding 9 miles from starting point, 1st class 25 cts., 2d class 15 cts., 3d class 7½ cts.; distances over 9 miles and not exceeding 90 miles, 75, 50, and 25 cts. for the respective classes; and for all distances over 90 miles, $2.50, $1.50 and 75 cents respectively.

FALSE WORKS FOR BRIDGE ERECTION.

After the engineer has made his design, and the manufacturer has turned out of his shops the finished parts of a bridge, it must be erected before it can be devoted to its ultimate use.

This subject of "Bridge Erection," though really important, has been very generally ignored by writers upon engineering detail; and believing that a few general directions, embracing at least the more common methods, will not be unwelcome to our readers, we have prepared the following paper.

We give these directions with the general caution, that a practical knowledge of "the work to be done," seasoned with a very fair modicum of common sense, is as essential to success in this, as in any other branch of engineering construction. Each site will demand the form of false works best adapted to the surrounding conditions, and in selecting this best form the erector must finally depend upon his own judgment and experience.

In special cases "false works" such as we describe have been dispensed with entirely, and the iron-work erected by methods which take rank among the boldest feats of American engineering, and require technical knowledge and skill of the very highest order. The Eads Bridge at St Louis, and the Kentucky River Bridge, erected by C. Shaler Smith, C. E., are notable examples. For the purpose of our illustration we have adopted an iron through bridge, single-track, with panels 16 ft. between pin centers, and the lower chord 50 ft. above the surface of water.

The main posts *A* may be either round or square, and of a mean diameter proportioned to their length. If the bed of the stream is hard, and the water not too deep, these posts may rest directly upon the bottom; if the bottom is soft, or the water deep, piles should first be driven as shown at *N* on general elevation. The piles should be sawed off above high water and capped by an 8 × 12 cap, the cap to be secured to the piles by 1½-in. trenails, which latter ought to project about 4 in. above the top of cap, as shown in Fig. 3; this, when the post *A* is set up on it, prevents the toe of the post from slipping, and while less expensive than mortising, answers the same purpose. Each bent of piles, when driven and capped, should be connected with the preceding bent by at least two 3 × 12 stay-plank *J* to counteract the buckling tendency there might otherwise be between the pile and the post *A*.

If a stiffer support still is required, we can drive three piles under each post *A*, as at *M*, the center one sawed off and capped as before, and the outer ones, having been driven a short distance from the middle pile, pulled over and the three piles tied together by a 1in. bolt passing through the cap.

Another plan of supporting the false works, but not shown on our illustration, is employed when long and heavy spans are to be erected across a deep or navigable stream. In this case the false work would be a temporary wooden Howe truss, divided into two or three spans, as the length and weight of the iron truss or other controlling circumstances might require. These wooden trusses would then rest upon false piers of timber, and the piers in turn would generally be supported by wooden cribs filled with stone.

A support having been provided, either by the hard river bed, or in some one of the ways described, we can proceed to erect the bents of our false work. Each pair of posts *A* should be capped and braced before raising, as shown at "cross section;" the cap *B* may be either mortised, or secured by a drift-bolt to the post *A*; the braces *C* should in all cases be bolted to posts, and not spiked; a bolt ¾ in. in diameter is sufficient.

The bent having been completely framed may now be floated to its site and raised into position by means of the balance-beam. The balance-beam illustrated is made of two pieces of 6-in. × 16-in. timber, inclosing between them a plate of iron ⅜ in. thick, extending the entire length and width of beams, and the whole fastened together by ¾-in. bolts; it is provided with a sheave and a 1½-in. diameter eye-bolt at the outer end, and a winch for hoisting at the inner end. In place of the winch a second sheave may be located at the inside end, and the fall led off to a hoisting engine. The length of the balance-beam should exceed somewhat the length of two panels of the bridge to be erected; the beam shown is safe for five tons.

We omitted to say in its proper place that the posts *A* and their supporting piles, if any, should be spaced so as to come directly under the posts in the bridge to be erected.

In starting from the bridge abutment, the balance-beams are weighted at the inboard end, or otherwise securely tied down; the bent can now be raised, and as soon as it is in position, held there by 3-in. × 12-in. stay-plank spiked to the top of the cap *B*. As the work advances, the beam is held down to the rear cap *B* by two stirrup-plates of iron ¾-in. × 5-in., with two bolts 1-in. in diameter, as shown on plan, and if there appears to be any danger of lifting the rear cap, more stay-plank can be put in place, and the bent weighted down.

For heights of false work of 40 ft. and under the longitudinal 2-in. × 8-in. bracing *C* is not needed, and by catching drift or exposing an increased surface to the current, in case of a rise in the river they might do harm.

Should a passage way for small river craft be required we may provide for it as shown on general elevation. In this case we can build a simple truss by taking a 12-in. × 14-in. stick for the upper chord and two 8-in. × 8-in. pieces for the posts. For the tension members we can in many cases use the end bottom chord links of the bridge itself. The castings necessary are shown at Figs. 1 and 2. They are simple and effective. The pins used in this case are the regular bridge pins. In providing the opening described the false work bents would first be erected from each abutment and the trusses swung into place finally either by the balance-beam or they may be lifted by a pile-driving machine if such is at hand. The 8-in. × 8-in. posts are fixed at the top by a short iron dowel-pin and when in place they are cross braced by 2-in. × 8-in. planks bolted on.

The five lines of stringers *D*, of which four lines are 10 in. × 12 in. and the center line 8 in. × 12 in. are put upon the caps *B* in, say, 34 ft. lengths; they lap past each other at the caps *B*. The outside stringers should be placed with their center 18 in. outside of center line of bridge trusses, the two other 10-in. × 12-in. stringers just inside the line of iron work. Across these two lines of timbers rest the 8-in. × 12-in. blocks *F* with their centers about 2 ft. each side of the center of the bridge post. For *E* we can use the cross-ties of the bridge; 3-in. plank thrown upon these ties form a footway for the workmen.

Great care should be taken in setting the blocks *F*; the exact center line of each truss should first be run, and the blocks *F* so set that they conform in height to the line of the bottom of the bottom chord links, including the camber of the bridge to be erected. It is better that the blocks be placed rather high than the least too low; if too high they can be chipped out, or by knocking them away from the center line of bridge posts the weight of the structure will spring the links sufficiently to bring them down; if too low the end connections cannot be made, and the whole mass must be raised.

As far as our description goes we could now use either upper false works, or a "traveler" for putting in place the bridge posts and top-chord segments. In a wooden structure, such as a Howe truss, where the top-chord must be laid out and packed in its entire length, upper false works are necessary; and unless we should have three or more 150-ft. iron spans, or a very large number of small spans, the "traveler" would not be economical.

Leaving the "traveler" for future consideration, we will describe the method of erection by upper false works. About 18 in. from the center of bridge post we erect an 8 × 8 post *L* and brace it in position by the 2-in. × 7-in. brace *K* spiked to the post, and the outside of cap *D*. The upper false work cap *O* is an 8-in. × .10-in, halved on to the post, and bolted to it by a ¾-in. bolt; 3-in. stay-plank, laid on the caps *O*, furnish a footway. At either end of the upper false works a "gin-pole," or mast, rests upon the cap *D*, and is securely bolted to the upper part of the post *L*, and well braced in place by means of this "gin-pole;" the upper chord segments are hoisted up and transported upon "buggies," or small wooden rollers in a frame, to their ultimate place.

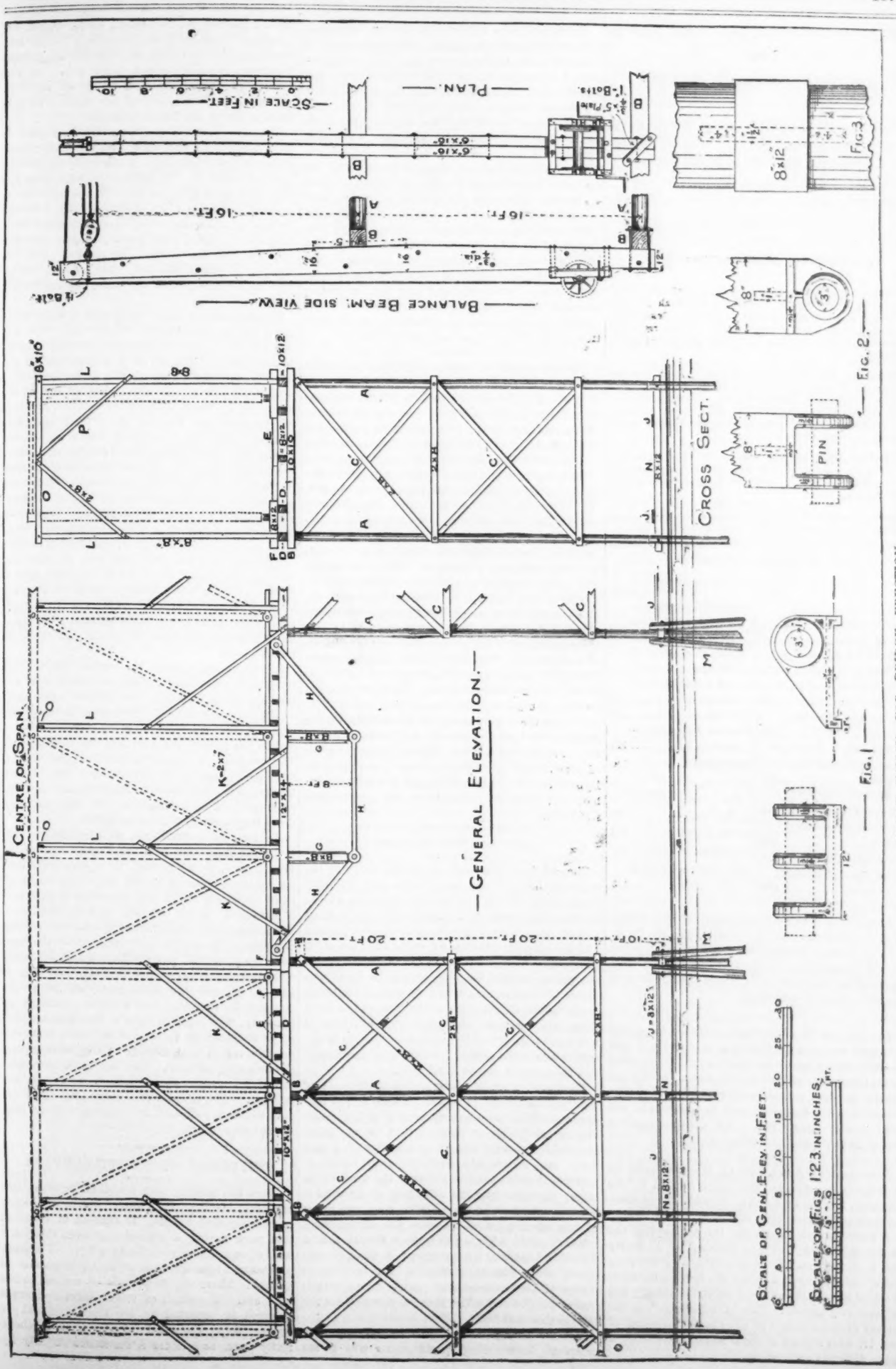
The erection of the iron work of the bridge may be briefly described as follows: We will suppose the maker of the bridge material has sent with it an "erection plan," on which the position of each member in the completed structure is shown, and each piece of iron is identified by letters and figures painted upon it, corresponding with similar marks upon the "erection plan."

As previously mentioned, the utmost care must be taken in fixing the position of bottom chord links, adjusting them to center line of trusses, and to the crown in the bridge. The bottom chord links being all in place, we next proceed to erect the posts, commencing in the middle of the span. As soon as the posts are hoisted up, which is done by a fall suspended from the cap *O*, the bottom pin is put in, taking care that the bottom of the diagonal ties and counters are at the same time secured. When the top chord segment is in place, hoist the diagonals into position and put in the top pin; run up both sides at the same time, and as each panel is completed, put in the top and bottom lateral systems. Proceed in this manner from the center of the span to the ends until the structure is completed and in a position to take care of itself.

In short span iron bridges, where the top chord is frequently built in three segments of several panels each, we can substitute for the upper false-works a pair of wooden trestles or "horses" that can be shifted from place to place.

For many of the most valuable hints and suggestions given in this description, and in fact for the data in great measure upon which it is founded, we thankfully acknowledge our indebtedness to Mr. D. S. Cofrode, of Jersey City, who, as a practical bridge erector, has a well-earned and deservedly high reputation.

The method of erection by a "traveler" will receive attention in a following number of ENGINEERING NEWS.



FALSE WORKS FOR BRIDGE ERECTION.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

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SATURDAY, MARCH 24, 1883.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe and Mexico, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belong to the province of this Journal is solicited.

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APOLOGY.—We owe an apology to Mr. Bland, in giving him the title of "ASST. Engineer, Philadelphia Bridge Works," in publishing his paper upon "Computation of Moments of Inertia in I Beams," in our last number. He is the Engineer of the above named company.

THE BERLIN IRON BRIDGE CO.—Owing to greatly increased business in building iron bridges and manufacturing heavy iron girders, the Corrugated Metal Company, of East Berlin, Conn., at the last annual meeting, considered it expedient to change the name of the corporation to that shown in the head line given above. All communications should be addressed accordingly.

TRANSACTIONS AMER. SOC. C. E.—We have received "Transactions of the Amer. Soc. C. E." for January, 1883. It contains a "Description of Some Experiments on the Flow of Water made during the Construction of Works for Conveying the Water of Sudbury River to Boston," by A. Fteley and F. P. Stearns. This is an extremely interesting andvaluable study and record of experiments upon the flow of water over weirs, most thoroughly and exhaustively treated. The "Proceedings" of the society give the results of the annual meeting of Jan. 17, with reports of the Board of Directors and of the different committees.

SUDBURY RIVER ADDITIONAL WATER SUPPLY.—The most elaborate and at the same time one of the most valuable public reports we have lately received is one just sent us with the compliments of the "Boston Water Board." It is entitled "The Additional Supply from Sudbury River, and Description of the Work." The Report is the work of A. Fteley, the Resident Engineer, Additional Supply 1873-1880, now Prin. Asst. Eng. of Boston. The contents include a history of the work in detail, superbly illustrated by 50 folio plates; the land and water damages; the quality of water; and water gauging—this last is probably the most complete set of experiments under this head anywhere recorded; the data given is of extreme value. The edition of this Report is limited; it is printed "for preservation, as forming a portion of the history of the Boston Water-Works," and not for gratuitous distribution; but we understand that a small number of copies may be purchased on application to the Water Department of Boston.

"PANCLASTITE."—Various opinions have been formed as to the new explosive called *Panclastite* (I break all). Whether dynamite is to be replaced by this "universal smasher" remains to be seen. M. Turpin says of it: For industrial purposes it is composed of two liquids—soluble in each other—inoffensive when separate, but constituting when mixed, without any other operation, a more powerful and rapid explosive than pure nitro-glycerine. One of the liquids, hypoazotic acid, furnishes the oxygen for combustion at the moment of explosion. The combustible liquid may be one of the following bodies: Sulphuret of carbon, petroleum, mineral essences, benzols, animal or vegetable oils, nitro-benzine, and allied substances. The mixtures may be made of various degrees of explosiveness. The principle, too, is the dominant one of all explosives—to set free oxygen in one body and have it act on another highly combustible substance. The most delicate composition of *panclastite* presents the following reaction: $2CS_2 + 3AzO_4 = 3Az + 4SO_2 + 2CO_2$. Experiments are now being made by the French Ministry of War, and when these are brought to a conclusion some definite idea may be formed. At present it would appear as if no superiority, from a practical point of view, could be claimed for the new explosive. Dynamite will continue to remain the most available, and, everything considered, the safest explosive force.

THE LOWEST TENDER.

The wisdom of awarding a public work to the "lowest bidder" has been often and seriously questioned. Much can be said against it, and as much in its favor. If the millenium was at hand and all men were honest—engineers, contractors and the corporate bodies as well, who too often control the actions of both of the classes named—the matter would be very simple in its adjustment. But such, alas, is not the case; the business world is honest just so far as the business in hand does not concern money-getting; self-interest will nearly always tip the scales of justice to the wrong side, outweighing the dictates of conscience and the sense of justice to all men.

The question to be really solved in the case of the "lowest bidder" is whether it is an honest tender, emanating from a party who is either naturally or artificially so situated that he can fairly underbid his competitors: or whether it comes from one dishonestly inclined, who hopes to make "all ends meet" by shirking the work to be done. In either case the difficulty of solution is apparent, for he who must decide may not know of the advantages of the one nor the intended trickery of the other. The system should not be denounced because it sometimes fails through collusion with dishonest officials, nor because so many of the contracts let under it are notoriously "bought and sold." It is the man and not the system that is at fault.

Honest, stringent but just interpretation of complete, far-reaching specifications will go far toward making the fraudulent bidder regret his misplaced confidence in his ability to do bad work; and the contractor who has the advantages mentioned is fairly entitled to his gains; for the knowledge he possesses of means or material which enables him to outbid his rivals is his personal property, his capital in trade.

Collusion between engineer and contractor is more difficult to deal with, and no matter how stringent the written law, it can rarely be entirely provided against. We believe that such cases are rare, and where they to do exist, the corporation is mainly at fault in accepting the "lowest tender" of some incompetent or dishonest engineer, in the belief that brains, integrity and experience are not worth the market price. A "cheap" engineer does not always imply cheap work to those who foot the bills, but rather the reverse.

To illustrate, we have lately seen a case ventilated in the press, where "solid rock" was set down in the "probable quantities" as estimated at 30 cubic yards. The bid on this item was $50 per cubic yard, and the bids on the larger quantities sufficiently low to win the award of the work, when the different items were scheduled; when the contract was finished, the "final" measurement increased the quantity of "rock" to such an extent that the work cost some $14,000 more than the original estimate, and the contractor was that much in pocket above his competitors. This case, as it stands, *might* have been an honest transaction, and the ultimate profit nothing more than the legitimate gain of a shrewd contractor, who, from his personal observation, was willing to take the risk he did; but the conditions surrounding the case in question throw a different light upon it entirely, for the "plot thickens" when we discover that the successful bidder was the son of the engineer, who was supposed to know, or at least had it in his power to estimate, the quantity of "rock" as finally given.

In declaiming against the system of "lowest tenders" in contracting, might we not as well extend our denunciation to the public "price list" of the business world? "Sixty to seventy per cent. off list," is a common thing in trade; in other words, the printed list is false in its information. The purpose is apparent, the discount can be adjusted to meet the requirements of the "lowest tender," for while one man may demand a profit of 20 per cent. on his material, his neighbor may deem the fourth of that all sufficient.

As long as corporations, like merchants, will buy from him who sells what they want at the lowest price, we see no way of rejecting the lowest bid, and, honestly carried out, the system is all right; it is only when the executive department is "crooked" that it can fail. A well-intentioned but incompetent and ignorant lowest bidder may complicate the system somewhat, but if the contract is carried out, he pays the price of his want of knowledge or experience, and the only way to provide against the contingency of loss to the company by reason of such a bidder throwing up his work, is to reject at once a bid, whether lowest or not, that to an expert engineer, bears evidence of a lack of experience in the market price of labor and material. This option is generally provided for under the expression of "lowest and *best* bid." The latitude thus given may open the door to fraud, but block the opening with an honest and able official, and all is well again.

THE POSTAL TELEGRAPH COMPANY.

There has recently been stretched between this city and Cleveland, O., a line of wire which is giving remarkable results. It consists of a core of steel wire having a diameter of seven thirty-seconds of an inch, surrounded by a layer of copper, producing a total diameter of about a quarter of an inch. There are 500 pounds of copper to the mile and 200 pounds of steel. Increased tensile strength is imparted by the steel core, and the copper, being deposited by electricity, is chemically pure, and offers a resistance of only $1\frac{7}{10}$

ohms to the mile. Several telephones of different makes have been used on this line, and no difficulty experienced in understanding what was said.

The compound wire is part of the plant of the Postal Telegraph Company, whose building, at 49 Broadway, this city, we recently had the pleasure of going through.

In one of the uppper rooms we found the Gray harmonic system of telegraphing in operation. As this has been described heretofore, we will only allude to the principal features. It is a well-known law of acoustics that tuning forks of the same pitch will vibrate in unison. If several tuning forks giving different notes be placed within sound of each other, and one struck, all will be silent except the one pitched to the same key. And as the responding one will take up the vibrations, whether upon the same key or an octave higher or lower, there is a practical limit to the number of forks that can be used. The harmonic system makes use of this fact. The instruments we found were four in number, and were so arranged that waves of electricity—broken circuits—were sent over the wire at the following rates: one instrument vibrated at the rate of 178 per second, the next 225, the next 275, and the last 303. These figures were ascertained by counting the number of dots impressed on a moving tape during a second of time. These waves will pass over the wire without interfering with one another, and at the other end each will select the instrument vibrating in unison with itself. These vibrations are so rapid as to produce a practically closed circuit on the sounder. The ordinary Morse alphabet is used. Four messages can be sent over the same wire at the same time, and also in combination with the duplex system.

The expression "sending a thousand words a minute" does not mean the taking a message of that many words and forwarding it at that rate. A brief explanation of the apparatus will make the meaning plain.

A cylinder of copper (iron has been used as well and as successfully) revolving upon its axis receives upon its upper surface ink from a wide flowing pen. This band of ink is broken into the dots and dashes of the Morse alphabet by an ordinary key manipulated by the operator, breaking or making the circuit and raising the pen from the cylinder, thereby leaving a blank space in the ink line. After the message has been placed upon the cylinder, which is kept warm by a gas jet in the interior to more quickly dry the ink, the pen is removed. In its place appears a stylus terminating in a little wheel resting on the line of ink. The current of electricity passes through the cylinder to the stylus when it rests on a blank space and thence out over the line to the distant receiving station. The direction of the motion of the cylinder is reversed and the speed greatly increased—or to a speed corresponding to one thousand words per minute. A horizontal motion parallel with the cylinder is imparted to both the pen and stylus by a screw extending across the machine and into which either may be geared. After the message has been placed upon the cylinder it can be sent to different points where needed. Before the ink becomes worn and broken about twenty messages can be forwarded. The cylinder when receiving a message can be revolved at a speed corresponding to the skill of the operator.

A key-board resembling that of a piano, and in which each key when depressed produces a letter on the cylinder in Morse characters, is found to be more accurate and rapid than the hand without any of the latter's eccentricities.

In the rear of the key-board is a series of little wheels—one for each key—furnished with projections engaging with a spring in such a manner as to produce in one turn the characters corresponding to that letter and which are printed on the cylinder in the same manner as the key worked by hand. Directly below the row of little wheels is a revolving cylinder of rubber barely touching them, though sufficient to impart motion when the confining catch is lifted by depressing the key.

The messages are received on a prepared slip of paper, moving very quickly under a hair-wire of oxidized steel, a portion of which is deposited upon the tape at each passage of the current. In this way t he brakes and dots in the ink line on the cylinder are recorded on the tape. The message is prepared by aid of a type writer for delivering.

All the experiments of this company have resulted most successfully, both with wire and instruments, and judging from the demand for extended telephonic facilities and rapid transmission of messages, financial success will attend.

We are indebted to the officers of the company for their kind courtesy while inspecting their building, and for the explanations of the inner workings of their apparatus.

ELECTRICITY AND CIVIL ENGINEERS.

In his inaugural address, recently, the President of the Paris Society of Civil Engineers thus alluded to electricity: "I am compelled to speak about it," he said, "although I am not an electrician, and even for the very reason that I am not one." M. Marché is a vice-president of a gas "technical society," and his leaning toward gas was rather unduly exemplified. Without wishing to enter into the contest of electricity *versus* gas, which is often being more successfully fought, as regards the former, in the speculative regions of stock exchange than in the practical work of every-day life, it may be asked, what will be the position of our civil engineers to electricity? Will it be incumbent upon many of them to acquire some necessary practical idea as to electricity, or must it become a specialty in itself. The French president of our confréres stated very dogmatically that civil engineers were unacquainted with the principle of electrometry and "the new scientific language."

We believe that the part which would naturally fall to civil engineers in the laying down or putting up—as the case may be—of wires and of the various dispositions of electrical apparatus would necessarily be comparatively small, and would in any case be confined to the larger cities. At the same time, it is evident that the applications of electricity must continue to grow, and this if only for the reason that the best scientific and mechanical talent of the world is now being focussed on electricity as it has not been on any element since the earlier days of steam.

The invention, the manufacture of new apparatus, etc., belongs to the electrician, machinist or scientist as may be, and the civil engineer can certainly have nothing to do with this branch. That there are many cases in which his services will be required in laying down electric apparatus does not admit of doubt, while, on the other hand, electricity may be usefully employed in many engineering works, especially tunneling, night work, etc.

To have a certain knowledge of the nature of electricity and its practical uses as regards his profession, is therefore incumbent on the engineer of the present day. The relation of the civil engineer to electricity is somewhat similar to that which he holds toward dynamite. The latter agent is a most useful auxiliary, though dangerous, and the engineer is bound to make himself perfectly acquainted with its nature and methods of use. He does not require at the same time to become a "dynamist" in any sense of the word.

The great field of the engineer will remain, however, as it long has been, the vast regions of our country, where if he has passed at all, it has been only cursorily, and where with the increase of population and wealth, his services will be required in ever increasing proportions.

LOUIS QUIEN, late assistant engineer on the Harrisburg & Western Railroad, sailed in charge of a party, March 15, for the Isthmus of Tehuantepec.

COST OF LABOR IN FRAMING AND ERECTING A WOODEN HOWE TRUSS BRIDGE.

We have had sent to us a very full and careful set of notes, detailing the actual cost for labor of framing and erecting five spans of 150 ft. each, of a wooden arched Howe truss bridge, built by one of the best known firms in the country. We give an abstract of these for the benefit of any whom it may concern. The general dimensions of the bridge were as follows:

Number of spans	5
" trusses to each span	2
" arches to each truss	2
Length of truss, c. to c., of end angle-blocks	149 ft. 4 in.
" panel over pier	2 " 8 "
Number of panels in each truss	14
Length of each panel	10 ft. 8 in.
Projection of chords beyond center of end angle-block	2 "
Height of truss between chords	20 "
Depth of lower chord	14 in.
" upper "	12 "
Width of chord	2 ft. 3 "
Depth of arches (3 pieces, 8 in. × 9 in., 1 in. spaces)	2 " 5 "
Width "	8 "
Width of bridge in clear between trusses	19 ft. 4 "
" " " " arches	18 "
Radius of upper line of arch	108 " 4 in.
Length of bridge centers of end angle-blocks	757 " 4 "

The wages paid were as follows: Foreman $3.60 per day, carpenters $2.75, helpers $2.25, and laborers $1.85. Work was commenced in October, 1873, and continued without interruption thereafter until July, 1874, when the bridge was completed.

The cost of the work may be itemized as follows:

Framing Arches, cost	$495.31	
Painting arches, "	29.70	
Total	$525.01	or 66c. per lin. ft. bridge.
Framing trusses, cost	$2,002.62	or $2.64 " " "
Painting daps, etc., cost	105.70	or 14c. " " "

Framing the false works, making "balance beams" for raising, making a flat and preparing generally for the erection of bridges cost as follows:

Framing false works	$57.90
Preparing for raising	173.98
Painting iron	42.75
Total	$274.69

Time consumed in framing false works, 3½ days' work of 7 men.

The cost of raising—for one foreman and 19 men, working 79 days, including a bill of $220.61 for watchman, horse, blacksmithing and expenses—was $2,989.45; reduced to cost per lin. ft. of bridge this amounted to:

False works	$57.90	or $0.08 per lin. ft. bridge.
Painting iron	103.65	" 0.14 " " "
Raising bridge	2,989.45	" 3.94 " " "

Or, to summarize under the following general heads, the

Framing cost	$2,003.63	or $3.44 per lin. ft. of bridge
Raising cost	3,151.06	" 4.16 " " "
Total cost	$5,754.69	" $7.60 " " "

The cost of lumber and iron is, of course, not included in the above account, which simply covers the labor.

PERSONAL.

JOHN S. BURDETTE, late asst. paymaster N. Y. Central R. R., has just been appointed paymaster, vice CHAS. REED, resigned.

Mr. JAMES L. FRAZIER has been appointed Superintendent of Roadway, Bridges and Buildings of the Chesapeake, Ohio & Southwestern Railroad Co., with headquarters at Louisville, Ky. The appointment took effect March 6.

Mr. EDWARD G. TILTON, the contractor's chief engineer and general superintendent on the Canadian Pacific Railway, has resigned his position. Mr. TILTON will take up his abode in Oregon or Washington, where he will devote his time to private practice and contracting.

Mr. FRANCIS SETH EASTMAN, a young civil engineer of rare promise, the inventor and builder of the cars for transporting the live fish with which the government, under the direction of Prof. BAIRD, is stocking the waters of the country, died in Washington on the 12th inst. He was formerly a resident of Portsmouth, N. H.

General Manager BUELL, of the Toledo, Texas & Rio Grande, has made the following appointments of division engineers: Mr. C. A. MILLER, division No. 1, Metcalf to Newton, office at Martinsville, Ill.; Mr. HUGO WILSON, division No. 2, Newtonville to Johnsonville, office at Flora, Ill.; Mr. W.

R. SMITH, division No. 3, Johnsonville to Frankfort, office at Belle River, Ill.; Mr. C. R. HARRIS, division No. 4, Frankfort to Eltham, office at Carbondale, Ill.

BUFFALO, March 18.—The body of D. C. MOFFATT, a civil engineer of Olean, who has been missing for six weeks, was found near the station of the Buffalo Road, in Olean, to-day. His jugular vein was severed and he had a pen-knife in his hand. MOFFATT was about 60 years old, was doing a prosperous business, and was well thought of. He had a wife and son somewhere in the East, but had not lived with his family for several years.

We notice from recent Pittsburgh and Baltimore papers that Mr. THEODORE COOPER, of 35 Broadway, this city, has been appointed consulting engineer for the Pittsburgh Junction Railroad, a new road now under construction through the city of Pittsburgh. During the past year Mr. COOPER has been acting as consulting engineer on the bridges and special structures of the Pittsburgh, McKeesport & Youghiogheny Railroad.

J. T. FURBER, Superintendent of the Boston & Maine road, is named as the probable successor of T. Phillips, general manager of the Toledo, Cincinnati & St. Louis.

ELECTIONS & APPOINTMENTS.

COL. A. L. RIVES, late general manager of the Mobile & Ohio R. R., has been appointed Vice-President and General Manager of the Richmond & Danville R. R. Co., Col. G. JORDAN, of the Houston & Texas Central, it is understood, will succeed Col. IVES upon the Mobile & Ohio R. R.

W. H. SMITH has just been appointed Manager of the Lackawana Fast Freight Line, to run over the Nickel-Plate, the Delaware, Lackawana & Western, and their agreed connections.

BOOK NOTICE.

WILEY & SONS have just issued a new, very neat and much enlarged edition of "EXTRACTS FROM CHORDAL'S LETTERS," comprising the choicest selections from the series of articles which have appeared under this title for the past two years in the columns of the *American Machinist*. The present work contains a steel engraved portrait of the author, Mr. James W. See, and a number of telling and well executed illustrations adapted to the character of the "Letters" themselves. As Mr. See says in his preface, "there is plenty of shop in these letters; good shop and bad shop," and the end aimed at is the advancement of the workingman through and by his own exertions. The pages abound in good advice, which is given in such a good-humored, racy, matter-of-fact way that it cannot fail to commend itself to all readers, whether they be mechanics, for whom it is especially intended, or those engaged in other pursuits. Price $2.

HOUSE DRAINAGE AND SANITARY PLUMBING, BY WM. PAUL GERHARD, C. E. PRICE 50 CENTS.—We are glad to see this essay, which was originally prepared for the last Annual Report of the State Board of Health of Rhode Island, republished in a handy form, making it readily accessible to all interested in the subject. There is no other book in existence which gives within the same limits of space a clearer and more correct exposition of the principles of house drainage, such as are now adapted by the best authorities. The original report was favorably received. In its present form it will be found instructive and useful to sanitary engineers and architects as well as to plumbers and householders. A careful consideration is given to the proper sizes and grades of pipes, to their joints, to the materials of which they are made, and to all of the essential elements of a system of plumbing. Besides stating the advantages of the usual methods and fixtures, the author in a very fair manner also points out their defects and mentions the dangers to be guarded against. We hope the little treatise will meet with the sale it justly deserves.

CORRESPONDENCE.

THE "NICKEL PLATE" RAILROAD.

NEW YORK, CHICAGO & ST. LOUIS RAILWAY COMPANY.
CLEVELAND, O., March 20, 1883.

EDITOR ENGINEERING NEWS:

A short time ago my attention was called to a letter written by a Mr. Moody and published in your paper of January 20, 1883. I had not deemed that letter worthy of notice, knowing, as I do, the person who wrote it. However, another letter, in reply to Mr. Moody, has been shown me, from Mr. Ernst Ruhl, late superintendent of the constructing firm of R. G. Huston & Co., which company built the Cincinnati Southern Railway and about 100 miles of the New York, Chicago & St. Louis Railway.

As it is clear Mr. Moody's attack is made not only against the interests of the New York, Chicago & St. Louis Railway, but is also directed against some of the best contracting firms in this country, and especially is that attack aimed at the official inspector of railways of the State of Ohio, therefore it is probably incumbent upon me once for all to reply to Mr. Moody and others like him.

The assertions of Mr. Moody are so untruthful ful that I am surprised a journal of such character as yours would insert such communications unless assured of the reliability of the matter presented for publication.

This Mr. Moody was employed a short time as clerk and copyist in the engineers' office of this company at Erie, Pa., but was retired from that place over a year ago, simply because we did not consider his services of sufficient value to us to warrant retaining him even in such an unimportant position.

The construction of a railway that will seriously affect the value of other lines naturally creates antagonism among the owners of properties affected. That such persons might perhaps express disparaging opinions relative to the new competitor, would not be unusual or unexpected Indeed, we have received numbers of attentions of this kind, yet never in a single instance have these courtesies been returned by those interested in the New York, Chicago & St. Louis Railway.

How unfounded many of the criticisms are, may be illustrated by reference to the charge that we use timber culverts, etc. *All* Western roads, and the *best*, use the same. To demonstrate this, permit me to say that, a few months ago, Mr. Reed, superintendent of bridges for the L. S. & M. S. Ry., was in my office and, incidentally, called my attention to a roll of plans and elevations showing *timber bridges, trestles and culverts* now in use on the Air Line Division of the L. S. & M. S. Ry. between Toledo and Elkhart, a distance of 133 miles. This is the main line of the L. S. & M. S. Ry., over which are run *all* the fast trains on that road. That record showed 264 *wooden* structures on that division. On no part of the N. Y., C. & St. L. Ry. of equal mileage have we the same average number of wooden structures.

The L. S. & M. S. Ry. has been in operation on that division for nearly twenty years, and with remarkable success and safety, and none will venture to say the L. S. & M. S. Ry. is not a good road. The L. S. & M. S. Ry., however, is not alone in thus using wooden structures. *All* of the best Western roads have more or less of them, and who thinks of criticizing those roads?

To demonstrate that the timber structures of the N. Y., C. & St. L. Ry. compare favorably with those of neighboring roads, it is merely necessary to state that during the heavy floods of last autumn, when bridges and trestles were washed away on old and good roads on all sides of the N. Y., C. & St. L. Ry., the latter lost not a single structure, *and has not to this day.* We have just passed through the most terrific floods ever known in the West. Old roads like the P., Ft. W. & C. and L. S. & M. S. Rys. have had large and costly bridges washed away, and masonry carried with them. We have not in a single instance had our track broken, and four hours have repaired such slight damages as have occurred to our road; and at no time during these floods have we been unable to pass our trains over the entire length of our road by reason of lost structures. I know no other new road of 500 miles in length can show such a record.

The principal point, however, made by Mr. Moody is as to defects of the great iron viaducts, and masonry supporting the same, built upon our road.

To reply to these statements, it is merely necessary to say the iron structures were built by the first iron bridge builders in this country, whose reputation are above the assaults of such men as Mr. Moody. These firms comprise: The Keystone Bridge Co., of Pittsburgh; The Delaware Bridge Co., of New York and Chicago; The Central Bridge Works, of Buffalo; Messrs. Rust & Coolidge, of Chicago, and others.

Statements by these great bridge companies, hereto appended, will effectually reply to the libelous communication of Mr. Moody.

The masonry for these structures was erected by Gen. J. S. Casement, who built a great part of the L. S. & M. S. Ry., the Union Pacific R. R., the Canada Southern R. R., and other great works. Gen. Casement had for his Supt. of masonry, Mr. J. C. McDonald, who for years had been Supt. of masonry on the L. S. & M. S. Ry. I will therefore, permit these gentlemen to reply as to the character of the masonry on this road.

The statement of gentlemen of such standing in the business world as those composing these great bridge companies, and of Gen. Casement, who has a continental reputation among railroad men as a *thorough* builder, must be conclusive upon the matter under consideration.

The fact is, our road is a *good one*, yet it *has* been hastily built, we are proud to say, but well built, as shown by the testimony of reliable persons, whose statements are appended hereto. We are running engines upon our road weighing 50 *tons*, and our superstructures are proportioned to carry that weight, and in safety. There are few *old roads* in the West that can carry such engines.

I append the paragraph taken from Prof. S. W. Robinson's letter that is made the pretext by Mr. Moody for writing his letter. The examination of our road by such a competent official and his opinion thereof is by far more reliable than that of a hundred such persons as Mr. Moody. I may add that Prof. Robinson's letter, from which this extract was taken, was received and published during my absence and without my knowledge. Hence I feel under obligations to demonstrate by unimpeachable testimony that Prof, Robinson is fully warranted in his opinion expressed in the paragraph appended from his letter.

This is the first and last notice that shall be taken of such items as the letter of Mr. Moody.

Truly yours, J. A. LATCHA,
Chief Engineer N. Y., C. & St. L. R. R.

[Accompanying Mr. Latcha's letter is one from William Hughes, the bridge engineer of the road in question, who states that the specifications under which the iron superstructure was built were identical with the specifications of the Cin. Southern, as to load, quality of material and workmanship; the material was subjected to test, and record kept for each lot of iron used; the bridges were built under rigid inspection, and the iron was manufactured in greater part by the New Jersey Steel & Iron Co. of Trenton, and the Carnegie Bros. & Co., of Pittsburgh.

We have also had sent us with the above, letters from the Lomas Forge & Bridge Works, Cincinnati, the Central Bridge Works, of Buffalo, the Keystone Bridge Works, of Pittsburgh, and the Delaware Bridge Co., of Chicago, who were the contractors for the iron works; each stating the amount of work done by them and the specifications under which they manufactured the bridges.

As we remarked in the NEWS of Feb. 17, we believe the public are entitled to all the facts in this case, and accordingly publish the above in justice to the road in question; we will only add

that the charges as made are entirely unsupported, and the evidence submitted is against the author of these charges.—EDITOR ENGINEERING NEWS.]

BRIDGE ACCIDENTS.

BY P. A. PETERSON M. INST. C. E.

The accidents that have occurred on this continent to iron railway bridges built within the last fifteen years have not been the result either of faulty design or of weakness of the material used, and while so much is being constantly written about design, nature of strains, safe loads, factors of safety, etc., little or nothing has been urged as to the duty of protecting the bridge, after it has been well built, from the accidents caused by derailed trains, which experience has shown to be its greatest, if not its only, source of danger.

A large percentage of railway bridges are so placed that all trains going toward them have to go down a grade and round a curve to reach them, and have another curve to go round and grade to ascend in getting away from them, and with heavy freight trains and light engines, drivers run very rapidly down the grade and round the curve over the bridge, in order to get up the grade and round the curve on the other side, and consequently bridges are often crossed with heavy freight trains at speeds exceeding fifty miles per hour. Of course engineers will report against this practice, and superintendents will issue orders against it, and drivers will endeavor to carry them out, till they get stuck in the grade two or three times, and are censured for not *making time*, when they return to their old practice and their old pace over the bridge, of which the superintendent takes no notice—he has issued his order and thinks he has done his duty in the matter—and when one of the many things that may throw a freight train off the track at this speed happens and pitches a locomotive or car into the end post of a bridge, knocking it out, and so throwing the bridge and train into the river, the bridge has to take the burden of the blame, and is found fault with for not fulfilling a duty for which it was never intended, and which it never should be called upon to perform.

Within the last five or six years bridge-floors have been very much improved, and generally, upon first-class lines, the floors are now so constructed that an engine can pass as safely over a bridge off the track as upon it, providing it does not run into one side of the bridge and knock out an end post or some other important member. Upon a few lines, rails running from a point in the center of the track, about one hundred feet from the end of the bridge diverge gradually, till near the face of the abutment they come close to the track, where cast iron inclines are placed to lift the wheels on the rails. This has been found very effectual when the speed has not been too great in putting derailed trains upon the track.

With good floors, proper guard rails and safety points, "deck" bridges are comparatively safe, but something more is required for "through" bridges. The first thing that suggests itself is that they should be widened. The writer made an attempt to have this carried out some six years ago, and endeavored to get two feet added to the width of all the bridges upon an important line of railway; he only succeeded in getting the addition of one foot sanctioned by the government, it being urged by the contractors as well as the builders of the bridges that even this was one foot more than the standard adopted on the American roads. The idea of additional width is, however, gaining ground, the Great Western Railway being the first to give a clear width of twenty feet between the inside of the trusses of its "through" bridges.

In addition to this increased width, there should be some manner of more fully protecting the end posts, and the most ready method of accomplishing this seems to be by means of heavy masonry walls laid in Portland cement and well dowelled together, carried up eleven feet apart, to the height of an ordinary passenger car. While it cannot be said that these modifications and additions will prevent all accidents to bridges, yet it must be admitted that they will go a great way toward it, and in such an important matter all that can be done should be done.—*Canadian Magazine of Science.*

IMPROVED SEWERAGE SYSTEM, BOSTON.—The improved sewerage system is gradually nearing completion, and the 300 feet of brickwork from the Cow Pasture to Squantum will probably be finished about June 1. If permission can be obtained sewerage will be discharged at Squantum, but if the city is required to wait until the system of works at Moon Island is in operation, it will be nearly a year before the much-needed relief is afforded.

NEW DEPOT.—The new depot to be built by the Pennsylvania Railroad Company at Harrisburg, and for which ground has been broken, is to cost $300,000.

NEWS OF THE WEEK.

READING R. R. AND THE SCHUYLKILL NAV. CO.—The stockholders of the Schuylkill Navigation Co., at a meeting held March 21, declined to consolidate with the Reading R. R. Co., apparently from a doubt of the ability of the latter company to carry out its obligations.

THE COST OF PUBLIC BUILDINGS.—A statement prepared at the Treasury Department and now in the hands of the printer shows the amounts appropriated and expended by the national government for public buildings in the States and Territories from March 4, 1789, to June 30, 1882. The total amount appropriated has been $88,462,262, and the amount expended has been $83,404,221, distributed as follows:

New York	$14,314,656.88
Massachusetts	7,670,023.96
Pennsylvania	7,482,469.42
Illinois	7,463,936.98
Missouri	6,134,068.63
Ohio	5,790,968.77
Louisiana	4,972,368.58
South Carolina	3,386,883.80
California	2,115,622.67
Maine	2,080,137.40
Maryland	1,864,602.80
Tennessee	1,139,044.18
Connecticut	1,074,925.43
Virginia	847,442.61
Kentucky	793,029.61
Michigan	781,073.41
Indiana	779,057.66
New Jersey	685,744.11
Nebraska	624,607.05
Wisconsin	601,723.74
Oregon	565,983.30
Minnesota	531,602.72
Alabama	527,896.03
Iowa	526,316.07
Georgia	498,648.21
North Carolina	454,005.63
West Virginia	384,903.60
Rhode Island	326,463.23
Arkansas	300,745.79
Texas	299,722.30
Vermont	252,270.38
Kansas	205,834.63
New Hampshire	173,670.96
Florida	156,220.85
Mississippi	138,275.16
Delaware	102,924.97
New Mexico Territory	97,824.86
Utah Territory	64,998.90
Washington Territory	61,753.83
Montana Territory	48,772.75
Colorado	44,154.84
Idaho Territory	41,738.15
Wyoming Territory	40,109.22
Alaska Territory	5,089.31
Dakota Territory	533.45
Miscellaneous repairs, etc.	6,947,868.51
Total	$83,404,221.54

This statement does not include the cost of the Mint buildings or the cost of any of the public buildings in the District of Columbia.

THE NEW POSTAL NOTES.—The post-office department is not required to furnish postal notes until Sept. 3, but it is thought that the blanks will be ready and the notes also by July 1. The time of issue is in the discretion of the department, except that the notes shall be ready not later than six months after the act became a law. The new notes will be about as large as a greenback, and of all denominations from 1 cent up to $4.99. The fee for the notes will be the same in all cases up to $5,—3 cents. The notes can be bought at the post-office as postage stamps now are. They are payable to bearer at any time within three months from the last day of the month of issue. One form is used for all denominations, the size of it being not only stated in the body of the note, but punched out at the office of issue. The note states where it was issued, and the name of the office to which it was sent. When the note is paid, the holder is required to put his signature upon it. Similar notes have long been in use in Great Britain, where they are very popular and useful. They are not, of course, in any country as safe against loss or fraud as the postal order, but they are more convenient, especially for the transmission of small sums through the mails. They take the place of the old fractional currency and also of postage stamps when used as currency. These notes will not be abandoned after their usefulness once becomes known to the people. The need of such currency has long been felt, and if the issue becomes very large no doubt the fee of issue will be reduced until the British scale is reached if not passed.

LAND GRANT TRANSFERRED TO THE TEXAS PACIFIC R. R.—The land granted to the New Orleans, Baton Rouge & Vicksburg R. R. by Act of Congress of March 3, 1871, has been transferred to the New Orleans Pacific R. R., now owned and operated by the Texas Pacific R. R. The President returned the papers with his approval on March 17. 68 miles of the road between New Orleans and Shreveport is excluded, as having been abandoned by the road above first named.

A METROPOLITAN RAILWAY FOR PARIS.—The Municipal Council of Paris have under way a scheme for a metropolitan railway, with two routes one along the central boulevards, and the other along those of Magenta and St. Michel. Disgust at insufficient omnibus accommodations inspires this enterprise.

RAILROAD BUILDING IN MICHIGAN.—The prospects for railroad building during the year are embodied in the following views by Deputy Railroad Commissioner Ransom: The preparations for the year's work provide for 600 miles of new lines. This is probably double the amount of any previous year. If the year's results bear out this anticipation, Michigan is expected to stand at the head of the list in amount of new roads constructed by any one state for 1883. The above estimate rests on no mere surmise. In a portion of the cases the grading is already partly completed and the iron on hand to lay the entire line. The roads on which the work is to be done are the following: On the Pontiac, Tuscola and Caseville the line will be completed from its present terminus at Imlay City to Caseville, at the mouth of Saginaw Bay, 75 miles, where it connects with the Alpena steamers. This is about 75 miles of road running lengthwise through the Huron peninsula (the thumb). The iron for this extension has been bought and is on the ground. The Michigan Central will be built from Beaver Lake to Alpena, 75 miles. The Michigan Ohio road will have 150 miles of road running this season. The Milwaukee, Lake Shore and Western road will build from its present terminus in northern Wisconsin into the upper peninsula of Michigan, running westward to southern end of Lake Agogebic, and thence to the Montreal river, 125 miles of this line being in this State. The Houghton and L'Anse road will be built this season, 40 miles in length, opening up rail connections with the copper region. The Jackson branch of the Grand Trunk is under contract, 40 miles in all. The ungraded line north from Marshall, about 100 miles, is expected to be among the completed lines before the end of the year. The Toledo, Ann Arbor and Grand Trunk has passed into the hands of the Garrison interest, and on the basis of information from the New York office it is down for about 100 miles of construction. There are 250 miles additional that may be constructed before another New Year's, and may none of it be built, and 150 miles besides the latter that are awaiting favorable contingencies, which may mature this year and may not.

SEWERING FORT WORTH, TEX.—A contract has been made with Mr. M. S. Hall for sewering the the city for $22,450.

LOCOMOTIVES FOR THE CHICAGO & ATLANTIC.—This road has ordered 46 new locomotives.

LARGE BUILDING.—About $200,000 will be expended by the Commercial Safe Deposit Company of Chicago in a new office building.

SUNSET RAILWAY.—The Pacific extension of the Sunset Railway is now graded sixty miles from Piedras Negras, and fifteen miles of track are laid. One hundred additional kilometers will be placed in the hands of the grading force immediately.

TOWING A STEAM DREDGE FROM PHILADELPHIA TO ASPINWALL.—The German steamship Claudius, from New York, arrived in this city last night to tow the new steam dredge La Comptesse de Lesseps from I. P. Morris' ship-yard to Aspinwall, for the Panama Canal Company. The distance is 2,000 miles. The Claudius was built in 1879, at Glasgow, and is known as a ten-knot craft. She will tow in a bridle faishion, with two hawsers, which will be made fast forward at the luff of her bow on each side, thus leaving her stern free to answer the helm. She is well supplied with steel hawsers, and will be provided with 1,500 tons of coal. The course will be to "skin" the shore from the Capes to Hatteras, thence across the Gulf Stream and head south for the Crooked Island passage. It is the biggest undertaking in the line of towing, except when the Bermuda Dry Docks were towed from Great Britain to the Bermudas. The dredge is heavily insured in this city, the underwriters objecting to any smaller vessel than the Claudius. She must leave here by March 16, so as to get to the southward of Hatteras before the equinoctial gales set in.—*Phila. Record.*

MEXICAN CENTRAL.—Track-laying has reached a point 284 miles south of Chihuahua.

GREEN BAY, WINONA & ST. PAUL.—This road will be pushed to St. Paul during the season, a distance of 120 miles.

COMPARATIVE PASSENGER RATES. In European countries passenger rates range no lower than in America, if on American roads rates were even adhered to. In Europe, however, the cutting of rates is not allowed. Second-class coaches in England cost three cents a mile. In Germany the rates are the same, although the accommodations are not quite so good. In Belgium three cents a mile is charged for first-class, two cents for second class, and 1½ for third-class. In Holland, the land of dykes, fares are higher, and two-thirds of the railroads are run by the government.

ELECTRIC LIGHTING OF CARS.—The Belgian Minister of Public Works has authorized the experimental lighting of a passenger train between Antwerp and Brussels, under the superintendence

of M.M. Barlet and Dery, engineers-in-chief, who are going to employ Tommasi accumulators to supply Swan, Maxim and Nothomb lamps.

THE VIENNA ELECTRIC EXHIBITION.—The Crown Prince of Austria, Archduke Rudolph, has consented to act as patron to the Electrical Exhibition at Vienna during the coming summer. It is intended that boilers, collectively of at least 1,000 horse-power, shall be laid down to work the generators, of which about 700 will be used for lighting the exhibition building, the remainder being employed for the transmission of power and for other purposes. Both engines and boilers will be exhibits, and will be so arranged as to give every facility for examination and comparison.

PROPOSED BRIDGE.—Mainstee, Mich., will vote upon a proposed $30,000 bridge loan.

WATER WORKS WANTED.—The question of waterworks will enter largely into the spring politics of Battle Creek, Mich.

A SOLAR HEAT POWER CO.—A company of this description has filed articles of incorporation in San Francisco. Capital, $10,000,000.

THE PROPOSED RAILWAY BRIDGE AT ST. JOHN, N. B.—President George E. B. Jackson and General Manager Tucker, of Portland, Directors Arthur Sewall, Esq., and Hon. T. W. Hyde, of Bath, of the Maine Central Railroad, and J. Murray Kay and Superintendent McLeod, of the St. John & Maine Railway, and Fred. E. Barker and Thomas R. Jones, of St. John, and B. Robinson, of St. Andrews, held a consultation recently in Bangor. One of the subjects under consideration was the building of the railroad bridge at St. John, N. B. As a result of their deliberation it was decided to commence the building of the bridge at once. The estimated cost is $600,000. When it shall have been completed the rails of the St. John & Maine will run directly from Vanceboro' and the Maine Central to a connection with the Intercolonial Railway in St. John, N. B., and transportation of passengers and freight will be much more easily and better accomplished than is now the case, with the ferry from Charleston to St. John, and the one missing link will be supplied to the great line of railroad track from Boston to Halifax.

MEGANTIC & MOOSEHEAD LAKE R. R.—Work is in active progress across Somerset County, Maine.

SEWERAGE, PORTLAND, OR.—A local paper publishes an article showing a serious condition of affairs in regard to sewerage. The city has no main sewer, has seventy-five miles of streets and only fourteen miles of terra-cotta drains, the largest of which is only fifteen inches in diameter. The most densely populated portion of the city is honey-combed with cesspools and vaults without any outlet.

NEW CALIFORNIA WATER CO.—The Manzanita Water Company has been incorporated at San Jose, to furnish water in Santa Clara and San Mateo counties and to the city of San Francisco. The capital stock of the company is $1,000,000, divided into 10,000 shares, and it is understood that the water supply will be taken from the Tuolumne River.

ARTESIAN WELL.—A well at Vernon Depot, Conn., has been sunk 200 feet, and the water stands within 6 feet of the surface.

WATER SUPPLY, RED BANK, N. J.—Owing to the failure of the Town Commissioners to make a contract for supplying the town with water, the insurance companies are actively engaged in canceling fire risks.

WATER RATES REDUCED.—A reduction of 30 per cent. has been made in the San Francisco water rates.

NEW COURT-HOUSE.—The Commissioners' Court of Bastrop, Texas, has accepted the bid of Mr. McDonald, of Austin, for building a new courthouse.

PIPE CONTRACT LET.—The Boston Water Board has awarded the contract for cast-iron water pipes for the Cochituate Department to R. D. Wood & Co., of Philadelphia. This bid was $36.80 for regular and special. The contract for pipe to extend the 48-in. main was awarded to A. H. McNeal, of Burlington, N. J., at $36 for 48-in. pipe, $36.50 for 24 and 30-in. and $70 for special work.

NEW CITY HALL.—The Richmond, Va., council has passed an ordinance appropriating $300,000 for the erection and equipment of a new city hall.

WATER SUPPLY, DENISON, TEXAS.—The city council has granted a franchise to the Denison Water Supply Company, giving said company the right to lay pipes through streets and alleys for the purpose of furnishing water for fire protection and domestic manufacturing purposes. The company will be able to furnish an abundant supply of pure, soft water for a population of 100,000 people.

NEW INSULATED WIRE.—Ever since the construction of the telephone system between Omaha and Council Bluffs much trouble has been experienced owing to induction, caused by the near presence of a large number of telegraph wires. To obviate this, it is now proposed to construct a cable, composed of seventy-five small copper wires, which are to be drawn through a lead pipe filled with paraffine, and around the whole is to be wound No. 14 wire in spirals, forming an armor to protect and strengthen it. This arrangement has been found to work very successfully, and the Omaha Electric Company have ordered a half-mile cable to be made at once and strung across the Missouri, in order to give it a full, fair test. If it turns out as well as now expected the company will use it quite extensively in the business center of the city, thus doing away, to a great extent, with the present objectionable pole system. The expense of the cable is greater at the outset than the old plan, but the cost of repairs will be much lighter, and it has many other points of advantage that will make it far cheaper in the end.

STRENGTHENING THE ST. CHARLES BRIDGE.—The work of putting double the number of wrought-iron posts in place to strengthen the St. Charles Bridge approaches has been commenced. When completed the trestle spans will only be 16 feet between ground supports, whereas at present the distance is 32 feet. In this way the lateral and perpendicular strength of the approaches will be more than double what it now is. The temporary piers that were cut down when the ice broke up have been replaced.

PANAMA CANAL WORK — LOCKPORT, N. Y., March 22.—L. Austen Spaulding, of this city, has closed a contract to construct seven miles of the Panama Canal, beginning on the Panama side. Steam dredges and derricks to be used in prosecuting the work are now being built in this city. Mr. Spaulding will go to Panama the first week in April, and will begin work upon the canal within six months.

NEW RAILROAD PROJECTS. — CINCINNATI, March 17.—Gen. Warner says the Ohio River road, which was first talked of in 1872, will be built during the present season. It will extend from Cincinnati to Point Pleasant, West Va., following the river on the Ohio side. At Point Pleasant it will connect with Senator Camden's road, which is now being built from that point to Wheeling. Another road of much more importance, if built, is the proposed Cincinnati, Wheeling and New York line. This will be an air line to Wheeling, from which point it is said a short route has been selected to Harrisburg and New York by way of Reading. The distance to New York from Cincinnati by this route would be 80 miles less than by the Pennsylvania Road, the present short line, and 192 miles less than by the Erie.

COMPRESSED AIR LOCOMOTIVE. — An interesting little pamphlet on the compressed air locomotive question, by Mr. Chas. W. Potter must be interesting reading to those unfortunates who have recently invested money in such enterprises. Four systems have been in the field in this direction, but the best results have been accomplished by the Hardie air locomotive, worked on the New York Elevated, when 19.1 cubic feet of air per ton per mile was consumed. This result was obtained after over six years of experiments, involving from $70,000 to $100,000 expended and irretrievably lost by a New York company. It appears that good results and bad results were practically reduced to the same level by the fact that, in all systems employed, at least two-thirds of the original power contained in the air was lost before it could be made serviceable as a motive power. Air may be stored in cylinders at a pressure of 1,000 pounds to the square inch, but it must be reduced considerably, say for example, to 100 pounds before it can be used in the cylinders of the locomotive.

PILE-DRIVING BY DYNAMITE.—In the course of executing some municipal work at Buda Pesth, the piles already driven were required to stand a greater load than had been originally contemplated. It was, therefore, necessary to test them, and drive still deeper those that yielded. On account of the expense of bringing a pile-driving machine successfully over each pile for so little work, it was determined to try the effect of dynamite; and the city engineers applied to Colonel Prodanovic, of the Second Regiment of Austrian Engineers, to carry out the experiments. According to the *Wochenschift des Oesterreichischen Ingenieur* and *Architekten Vereins*, the piles were cut square, and a wrought-iron plate 15 inches in diameter and 4½ inches thick was placed on the top of each. On its center, and immediately over that of the pile, was placed a charge of No. 2 dynamite, in the form of a cake, 6 inches in diameter and ¾ inch thick, and weighing 17½ ounces avoirdupois. This was wrapped in parchment-paper, covered with clay, and fired. The effect produced was found on an average to be equal to five blows from a 14¾ cwt. monkey falling from a height of 9 feet 10 inches. The iron plates stood from 20 to 24 explosions. The system is not considered applicable to a pile standing considerably out of the ground, but saves a great expense when piles already driven have to be sunk deeper.

THE LINCOLN, SALINA & FREMONT R. R. was organized March 17. This road is to run from Salina, Kan., through Beatrice, Lincoln and Wahoo to Fremont. The company is expected to be in working order in about sixty days. The directors are I. M. Burke, of Lincoln; W. H. Dickinson, of Wahoo; G. W. E. Dorsey, of Fremont, and S. C. Smith, of Beatrice.

NEW JERSEY CENTRAL.—TRENTON, March 20.—The Trenton *Times*, one of whose leading stockholders is Receiver Little, of the New-Jersey Central Railroad, contained the following editorial paragraph: "The *Times* can state, on the most reliable authority, that the rumors respecting the lease of the New Jersey Central Railroad by the Reading Railroad have no foundation in fact. No proposition respecting a lease has been made the New Jersey Central by any road. The Central does not need assistance, being in a position where it can take care of itself."

PROPOSED CENTRAL ASIAN RAILWAY.—A fresh project is just being ventilated, at St. Petersburg, having this end in view. The Volga, the Caspian, and the Amu Darya are to be utilized; a railway 340 miles would unite the basin of the Amu Darya in Central Asia with the great commercial highways of European Russia; the construction of such a railway is said to offer no great technical difficulties.

A BELT ROAD FOR CINCINNATI.—A new plan is on foot to secure a belt road for the city, or one that will answer all the purposes of such a road. The Cincinnati Eastern Connection Railroad, at a meeting held a few days ago, voted to increase the capital stock from $100,000 to $1,000,000, and it is said the company means business. The plan is to build a road from the Eggleston avenue connection track through the old tunnel around by Avondale and Clifton, and connect with the Marietta and Cincinnati Road at Cumminsville, and by this means connections can be made with all the roads entering the city on the west side. The scheme is a good one, and will very probably be brought to a successful issue, as energy and capital are back of the plan.

THE LONGEST R. R. TANGENT.—Major B. H. Green, Chief Engineer of the Mississippi & Rio Grande road, who for some time past has been engaged in running a line from Red River to Eagle Pass, on the Rio Grande, has a tangent, or straight line, on his survey, which is over 100 miles in length. This is said to be the longest tangent in the United States.

COSTLY ELECTRIC LIGHTING.—The whole problem of electric lighting having been reduced to the question of cost, all reliable calculations based on actual results must be welcome. On the 1st of January, 1882, a large railway station in California was lighted by a local branch of the Brush Electric Light Company. The dynamo was made to furnish forty lights, and worked by a fifty-horse-power engine. Everything was made of the best material, and put up by experienced workmen. Allowing six months to pass so as to permit the expenses to be cut down to a minimum, and the employés to be trained to the best efficiency, calculations were made for the months of June, July, August, and September, 1882, with the following result:

Average cost per month	$525.52
Average cost per night	17.06
Average number of lights nightly	30.09
Average hours of lighting nightly	5
Average cost of one light nightly	55 cents
Average cost per light per hour	11 cents

Mr. Samuel Purnell, who makes this report, comes to the following conclusion: He states that the local opinion was that while the station was brilliantly illuminated by electricity, and better than gas could possibly do it, yet that sufficient light could have been obtained from gas for half the money.—*N. Y. Sun.*

ATLANTIC & NORTHWEST RAILROAD.—This company is now surveying and will shortly build a line from St. Eustache to Smiths Falls, Quebec, via St. Andrews and Carrillon, where it will cross the Ottawa River. At Smiths Falls it will connect, via Perth, with the Ontario & Quebec, now in course of construction to Toronto. In reality this line is part of the Canadian Pacific. P. A. Peterson, of Montreal, is the chief engineer.

NORTHERN PACIFIC CONTRACTS.—It is understood that the new contracts for building the new line of the Northern Pacific from St. Paul to Sauk Rapids will be let in May, and work will commence afterward as soon as practicable.

ROANOKE, (VA.) SEWERAGE.—At a meeting of the City Council of Roanoke, Va., held on the 1st inst, the system of sewerage proposed by Rudolph Hering, Sanitary Engineer, was adopted. The cost of the proposed works is $20,262, of which the city pays about $21,000. The Roanoke *Leader* of the 15th, says:

"We are gratified to see that our City Council is taking active steps in this important matter, and heartily approve their action in adopting the report of Messrs. Flickwir and Skinker, which embraces

the system proposed by Mr. Rudolph Hering, the eminent sanitary engineer. The cost of $21,000, or even more, is moderate where the great advantages which will accrue are considered. It would have been better if this matter had received earlier and more energetic attention. The Council would have perhaps saved something and gained much valuable time if they had promptly adopted and put into effect Mr. Hering's recommendations last fall. We are glad to see, however, that there is now an evident disposition to push the work. Nothing more important or more essential could possibly receive the attention of the Council. As we have often urged, the foundation of the system can now be securely laid, and subsequent additions and improvements can be made as the growth of the city may demand."

LONG-DISTANCE TELEPHONE.—Letters patent have been awarded Myron L. Baxter for a long-distance telephone. Tests of the instrument were made last week over a line extending from New York to Cleveland, and it is said that conversation was carried on between the two cities. It is also said that words spoken at a distance of 63 feet from the transmitter were distinctly carried over a circuit of five miles, and that words whispered 17 feet from the transmitter were audible at the other end. It is reported that the company owning the patents will establish a telephone line between Washington and New York.

BORT.—The etymology of this word is not difficult to find. It is doubtless derived from the Dutch substantive *boor*, signifying piercer, borer, etc. Holland has long enjoyed almost a monopoly of the art of cutting and polishing diamonds and other very hard precious stones, and Amsterdam is still an important center of that industry. No substance will cut a diamond but a diamond itself, and for that purpose diamond dust is employed by lapidaries. In cutting a diamond every particle of the dust is carefully collected, to be afterward again used, but the chief supply of this dust is obtained by crushing to powder inferior diamonds, splinters and fragments of diamonds, and black or anthracite diamonds (sometimes called *carbonado*), all of which are collectively known in the trade as *bort*. Scarce any English dictionary or encyclopedia contains the word, which has long been in common use among diamond dealers and lapidaries to designate the inferior stones and fragments I have named. *Bort* is also much employed in rock-boring drills and for piercing holes in rubies and diamonds used in watch-making. The price of *bort* varies, according to quality, from 30s. to 50s. a carat. It is a very significant word.—*Notes and Queries.*

REMINISCENCES OF A VENDOR OF MINING SHARES.—William H. Falvey, a mining engineer and speculator, formerly of London, testified before United States Commissioner Osborn on the 17th for Erwin Archer, whose extradition to England for forgery is sought. The witness said that his business in London was to sell mining stocks.

"Were they good?" asked Mr. Marbury, counsel for the British Consulate.

"Not always," answered the witness nonchalantly.

"Who benefited by your operations?"

"I did."

"How about the purchasers?"

"Well, they usually lost."—*N. Y. Sun.*

RAILROAD WORK OF THE MAINE LEGISLATURE.—Acts of incorporation have been granted the Merchants' Marine Railway Company for the construction of a railway and wharves at Cape Elizabeth and the carrying on of any business connected therewith; to the York Harbor & Beach Railroad Company for the construction and operation of a railroad from some point on the Portland, Saco & Portsmouth Railroad in the town of Kittery or York to Union Bluff in the latter town; to the Bethel & Northern Narrow Gauge Railroad Company for the construction and operation of a narrow gauge road from some point in Bethel, Greenwood or Woodstock to Richardson or Umbagog lakes; to the Mechanic Falls, Poland & Gray Railroad Company for the construction and operation of a road from some point on the line of the railroad leading from Mechanic Falls to Canton, through the towns of Minot, Poland, New Gloucester and Gray to a point on the Maine Central Railroad in the towns of Gray, North Yarmouth or Cumberland.

The contract of May 4, 1871, and all additional contracts between the Eastern and Portland, Saco & Portsmouth railroad companies have been ratified; the time for the completion of the Bangor & Piscataquis Railroad to Moosehead Lake, extended to Jan. 27, 1886; the acquirement authorized by the Junction Railroad Company of Portland, of the franchises and all the property of the Portland Dry Dock, and the right to exercise all the privileges granted that company; the lease of the Kennebunk & Kennebunkport Railroad authorized to the Boston & Maine; the privilege granted the Ocean Street Railroad Company to extend its tracks into the city of Portland, and their operation as a horse railroad; the time for locating and constructing the Maine Shore Line Railroad extended to Feb. 1, 1877; the right granted for the construction and maintenance of a railroad from Ellsworth to some point on the Eastern Maine Railroad, and the running of its trains over the latter road to connect with trains going west; the extension of the Eastern Maine Railroad from some point on its present line to Mt. Desert authorized, and the organization of the company from the bonds of the Bangor & Bucksport Railroad Company ratified; the sale or lease of the Knox & Lincoln Railroad, and the change and extension of its location at certain points authorized; also, the lease or transfer of the franchise and property of the Old Orchard Junction Railroad, and the change of gauge by the Green Mountain Railroad, the time for the construction of the Penobscot Central and Passadumkeag railroads extended; the acts of the Bangor & Piscataquis Railroad Company and the city of Bangor legalized and made valid relative to the extension of that road.

The law relating to railroads has been so amended that charter limitations for the completion of a road shall not be construed to affect any portion of a road completed within the prescribed time and holders of not less than a majority of the scrip or bonds, due and payable more than three years, or on which no interest has been paid for more than three years, are given the right of commencing a suit against the corporation. Any corporation having organized as a narrow-gauge railroad may hereafter change the same to the standard gauge on application to the railroad commissioners, and a railroad may be built in the same general direction of any other and within ten miles of the same. The law relating to the taxation of railroads has also been amended so that horse railroads will hereafter be taxed one-tenth of one per cent. when the gross average receipts shall not exceed $1,000 per mile.

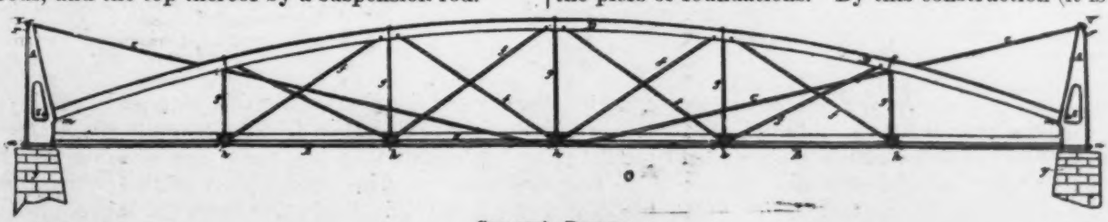
THE TELEGRAPH AND TELEPHONE IN MAINE.—Acts of incorporation have been granted the Harrison and Bridgton Telegraph Company, for the construction of a telegraph line from Bolster's Mills, in the town of Harrison, to any point in the town of Bridgton; to the Brunswick and Harpswell Telegraph and Telephone Company, for the construction of a line from Brunswick to Pott's Point and Orr's Island in the town of Harpswell; to the Bar Harbor & Ellsworth Telegraph Company, for the construction of a line from Bar Harbor through the town of Trenton to some point in the city of Ellsworth, and also from Bar Harbor through Mt. Desert to Ellsworth; to the Rangeley Telephone and Telegraph Company, for the construction of a line from Phillips to Indian Rock, in the town of Rangeley, or any intermediate point, with branch lines to Lake Umbagog or any other point on the Rangeley chain of lakes; to the North Franklin Telephone Company, for the construction of a line from Strong to Eustis, with branch lines to New Portland, Anson and Salem; to the Rockland & Vinalhaven Telegraph and Telephone Company, for the construction of a line from Rockland to North Haven and other towns; to the Bethel & Umbagog Telegraph and Telephone Company, for the construction of a line from Bethel Hill to Cambridge, N. H.; to the Atlantic Telegraph Company, for the construction of lines anywhere in the State; to the Ellsworth & Deer Isle Telegraph Company, for the extension of its line from Ellsworth to Bangor; and the construction of a telephone line is also authorized from Princeton to Grand Lake Stream.

TRUSS BRIDGES.

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

Sept. 22, 1857, Abram S. Swartz, of Buffalo, N. Y., devised a truss bridge which consisted principally in making iron towers or standards to support the arch, the base of which is held against the thrust of the arch by horizontal tension rods, and the top thereof by a suspension rod.



SWARTZ' BRIDGE.

The tower, the horizontal tension bar and the suspension rod, when taken together, make a figure in the form of a right-angled triangle, the foot of the arch resting upon the tower within this triangle.

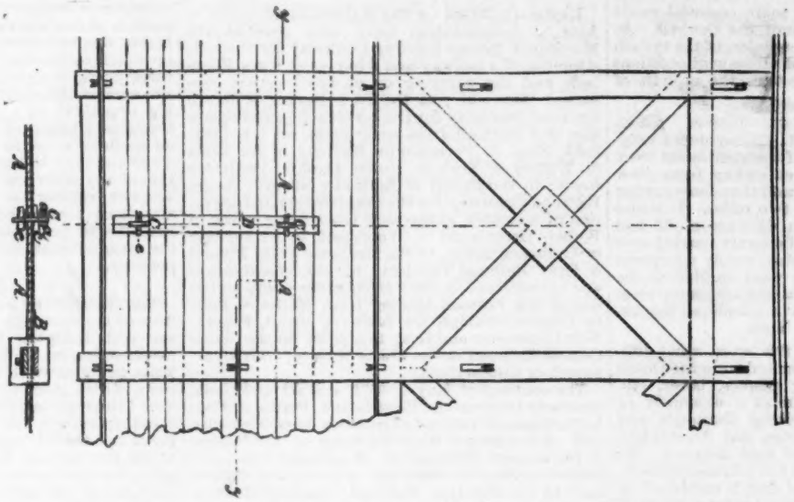
In the cut *A* represents the tower, which is made of cast-iron. The tension rods *B* pass through the flanges at the base of the tower, and are secured thereto by means of heavy screw nuts *n*. The towers sustain the whole weight and thrust of the arch *D*.

c represents the wrought-iron suspension rods. They are secured to the top of the towers by heavy nuts *V*, and pass through a slot in the arch segment. The arch *D* is made of circular segments of uniform cross-sections, joined by socket joints; *f* are the diagonal rods, and *g* the post; *h* are the cross-ties and *k* longitudinal joists. The arch rests upon the steps *m*.

Lowthrop's bridge truss consists in the manner of constructing and arranging the vertical posts that they may be allowed to vibrate in the upper and lower chords, and that the bottom of the end posts may be allowed to vibrate on the piers or foundations. By this construction (it is stated) the injurious effects of expansion and contraction on the structure, as well as on the piers, is avoided, and that the sudden shocks from passing trains are prevented.

In the cuts, which show a longitudinal elevation of a part of the truss frame and a top plan thereof, is shown (1) the vibrating post *g*, having a rounded top fitting the groove of the cap *e* at *t*, and a grooved bottom fitting the semi-cylindrical part *l* of the base *m*; (2) the posts *h h*, &c., and the diagonals *d d* and *c c*, passing through the lateral web or

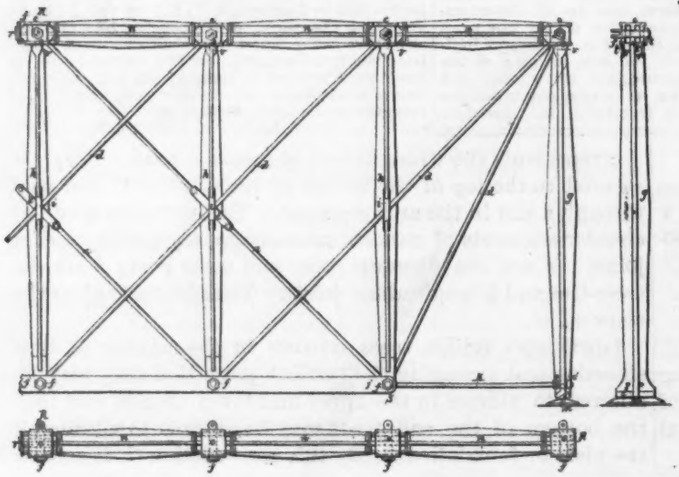
rib of the posts at *i i*. The flat part at *v v* at the top is for ornament merely, and should be rounded off so as not to interfere with the play of the posts; (3) the upper chords *R* are composed of the caps *e*, and the straining rods *n n*; (4) the lower chords are composed of the plates *j* connected by bolts *f*, on which the bottom of the vertical posts vibrate.



McKIBBIN'S TRUSS BRIDGE.

March 9, 1858, William McKibbin obtained a patent for a truss bridge.

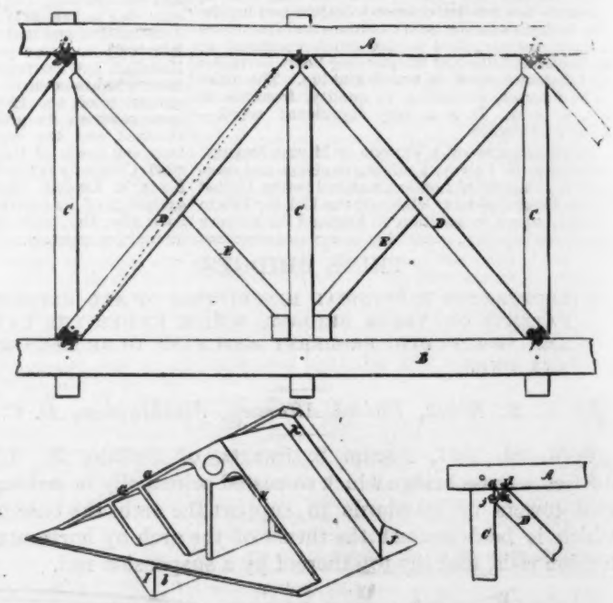
Refering to the cuts *A* are a series of flat iron bars forming part of a bridge girder. The ends of two lengths which are to be connected are bent at right-angles to form legs *a*, and narrow slots are cut through their ends to receive a wedge or taper key *c*. Between the lugs *a a* of the two lengths of iron *A* is fitted to a plate *C*. This plate has slots to receive the wedge or key *c*. A plate *D* is placed against the opposite side of the joint to that on which the lugs *a a* project, and is slotted for the plate *C* to pass through it. The sheathing *B*, when used, is simply applied to inclose the bars *A* on either side, holes being provided in the sheathing for the plates *C C*, and the lugs *a a* to pass through.



LOWTHROP'S TRUSS.

David H. Morrison, an Ohioan, in 1858 (April 27) received protection for a wooden truss bridge. Morrison makes provision for the elongation or enlargement of the panels of a truss by the shrinkage of the timbers, and the shortening of both main and counter-braces, thereby resulting in the settling of the truss.

D are the main brace timbers and *E* the counter-braces. The principal feature of the improvement consists in a device for transferring the thrusts of the braces of the truss wholly to the ends of the fibres of the posts and chords conjointly, instead of sustaining them wholly or partially on the sides of the fibres. For this purpose he employs a cast-iron right-angled shoe *I*. The position of the shoe is with its hypothenuse against the upper or lower chord as the case may be. The sloping sides of the casting consists of two plates *G H*. Projecting from the sole of the shoe and occupying a transverse gain or notch in the top of the lower chord or bottom of the lower one, is a flange *I*, whose bearing surface *b* is at right angles to the fibres of the chord. *J* is a similar flange entering again in the post for a similar purpose. By this construction the shoe is prevented from following the lateral shrinkage of either the chord or post with which it comes in contact.



MORRISON'S TRUSS BRIDGE.

(TO BE CONTINUED.)